Global Street Design Guide

Global Designing Cities Initiative

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NACTO

ISLAND PRESS

Global Designing Cities Initiative

Skye Duncan

Director, Global Designing Cities Initiative

The Global Designing Cities Initiative (GDCI) focuses on the critical role of streets within urban environments around the world. In partnership with the National Association of City Transportation Officials (NACTO) and working with a Global Expert Network, the GDCI is committed to sharing industry best practices, facilitating peer-to-peer mentoring, and fostering regular communication. The GDCI facilitates the exchange of ideas to help a variety of stakeholders shape streets to promote public health and safety, quality of life, multimodal mobility, economic development, environmental sustainability, and equity. GDCI believes that by working together, cities can save time and money, share lessons learned, scale up best practice implementation, and more effectively achieve their policy goals and objectives.

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Linda Bailey

Executive Director

Matthew Roe

Director, Designing Cities

The National Association of City Transportation Officials is a 501(c)(3) nonprofit association that represents large cities on transportation issues of local, regional, and national significance. NACTO views the transportation departments of major cities as effective and necessary partners in regional and national transportation efforts and promotes their interests in federal decision making. The organization facilitates the exchange of transportation ideas, insights, and best practices among large cities, while fostering a cooperative approach to key issues facing cities and metropolitan areas. As a coalition of city transportation departments, NACTO is committed to raising the state of practice for street design and transportation by building a common vision, sharing data, peer-to-peer exchange in workshops and conferences, and regular communication among member cities.

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National Association of City Transportation Officials
120 Park Avenue, 23rd Floor
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Consultant Team
ARUP, Nelson\Nygaard Consulting
MRCagney
Sam Schwartz Engineering

Design
Pure+Applied

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Foreword

Around the world, over 1.2 million people die on roads each year from traffic injuries, and between 20–50 million people are seriously injured. Bloomberg Philanthropies is dedicated to saving lives through interventions that are proven to reduce traffic fatalities and injuries. Since 2007, we've been working with cities and countries in low- and middle-income regions to adopt and implement road safety policies, promote public transportation systems, and design safer roads.

About three-quarters of the global population is expected to be living in cities by 2050. As they grow, cities must work to make their roads safer for all users, from motorcyclists to pedestrians. At the same time, climate change poses new urban planning challenges, requiring cities to build transportation networks that are both safer and more resilient.

The spaces, structures, and surfaces that shape our streets must be rethought, reimagined, and redesigned to function more efficiently and effectively for the needs of more people. We must be creative about the infrastructure we already have, and improve the capability of urban streets to support a healthy, livable, and sustainable future for generations to come.

That is why we have created this *Global Street Design Guide*, which provides strategies to help cities reduce speeding, prioritize sustainable mobility choices, and design safe streets for all road users. By taking bold action, cities can save lives and build a stronger foundation to support their future growth.

Michael Bloomberg,
Founder, Bloomberg Philanthropies
Former Mayor of the City of New York


give it back
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W 46 ST
ONE WAY
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WICKED

Foreword

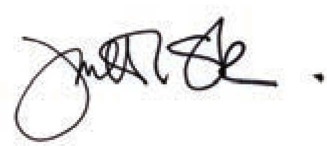
“The *Global Street Design Guide* focuses on the many roles that streets play in cities and the benefits that great street design can have on a city’s quality of life.”

Janette Sadik-Khan

For the last century, streets around the world have been built around automobiles. Wide lanes for traffic and little room for people became the rules of the road in most corners of the globe, dividing cities, stifling economic growth, and creating dangerous congestion. Tired of waiting for regional or national authorities to right these wrongs, a new generation of planners, engineers, urban designers, and city residents are working to take back their streets. Roads from Buenos Aires to Bangalore have become showcases for new designs that place people first and transform their roads into safe, attractive, and economically vibrant places.

Inspired by the work in 70 cities in 40 countries on six continents, this guide marks the next step toward changing the old road hierarchy, with designs that save lives, prioritize people and transit, reflect diverse communities, and better serve everyone on the street. The real-world case studies in these pages are a new global blueprint for safer, higher-performing streets and a permission slip for city leaders to innovate and translate these designs to their own roads.

With this guide, NACTO and the Global Designing Cities Initiative are building on design documents like New York City’s *Street Design Manual*, and the *Urban Street Design* and *Bikeway Design Guides*, and supporting the Bloomberg Philanthropies’ traffic safety efforts worldwide. As advancing technology and global commerce have erased borders and created new connections, the universal principles in these pages will help create a common language for world-class streets.



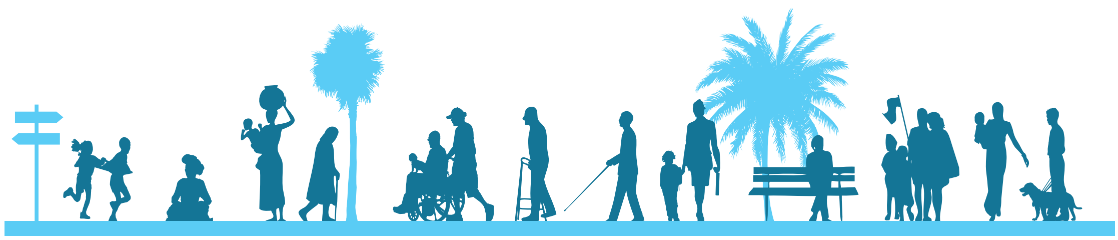
Janette Sadik-Khan,
Principal, Bloomberg Associates
Chair, Global Designing Cities Initiative
Former Commissioner of New York City Department of Transportation

New York City, USA

Prioritizing People in Street Designs

The Global Street Design Guide has been designed to inspire leaders, inform practitioners, and empower communities to design streets that put people first.

1. Pedestrians



2. Cyclists and Transit Riders

3. People Doing Business and Providing City Services

4. People in Personal Motorized Vehicles

About the Guide

The *Global Street Design Guide* sets a new global baseline for designing urban streets. Recognizing that cities are places for people, the guide shifts the parameters of designing urban streets from the typical point of view of automobile movement and safety, to include access, safety, and mobility for all users, environmental quality, economic benefit, enhancement of place, public health, and overall quality of life.

Participating experts from global cities have helped to develop the principles that organize the guide. Building on the successful tools and tactics defined in NACTO's *Urban Street Design Guide* and *Urban Bikeway Design Guide*, this new guide addresses a variety of street typologies and design elements found in various contexts around the world.

Funded by Bloomberg Philanthropies, this innovative guide will inspire leaders, inform practitioners, and empower communities in realizing the potential in their public space networks. By treating streets as public spaces that integrate varied functions and uses, the guide will help cities unlock the potential of streets as safe, accessible, and economically sustainable places.

Streets Around the World

Cities are growing quickly, and their streets are changing. Around the world, local investment is moving from highways and sprawl to transit and cities, and the role of design is shifting from building bigger roads to making streets that support quality places. Most people in the world live in cities, and vast majorities move on foot, by cycle, or in transit—but most public spaces in cities are currently designed for cars. This increasingly visible imbalance is shifting the way cities are planned. Streets must be designed to better balance the needs of more people.

Transportation decisions made today will impact the development of cities, the health and safety of their residents, their social equity and stability, the quality of their air and water, and the carbon they emit for decades into the future.

Fast-growing cities have the opportunity to avoid the highway-oriented mistakes of the 20th Century—mistakes increasingly recognized in countries that once invested heavily in roads and highways at the expense of sustainable and livable cities. This new world does not have room for the idea that advancement is associated with increased car use and infrastructure investment for private vehicles.

That belief is the foundation of the idea that only cars should be accommodated by streets and that people do not belong in public space.









Cities face a decision every time they invest in transportation: to cater to cars, creating sprawling highway networks and isolating vital urban centers, or to grow sustainably, promoting denser and more compact neighborhoods with greater transportation options and access. These are public decisions that affect the entire city, and—through their impact on climate—the entire world. High volumes of car traffic and reliance on personal motorized vehicles for urban transportation place high costs on society.

Designing urban streets to minimize auto-dependency and promote safe, sustainable alternatives can help address several challenges that cities struggle with around the world, including:

- Traffic Violence
- Physical Inactivity and Chronic Disease
- Poor Air Quality
- Economic Inefficiency
- High Energy Consumption
- Climate Change
- Noise Pollution
- Poor Quality of Life
- Inequity

Global Influences

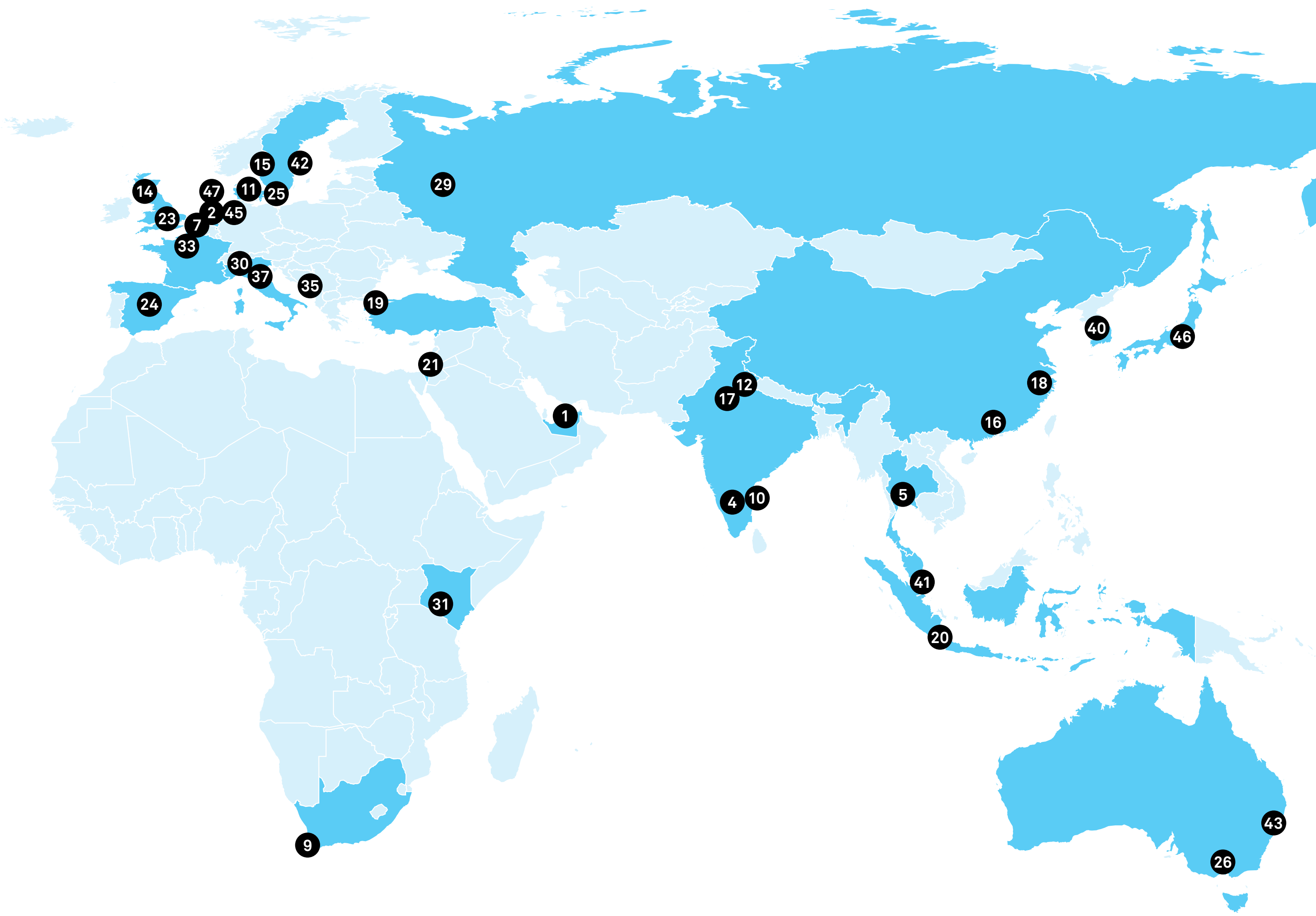
The *Global Street Design Guide* was informed by a variety of geographic contexts from around the world and has been created for global cities by global cities.

Each city offers lessons on the range of challenges presented in street design processes, as well as best practice strategies for others to learn from.

The case studies provided in the Streets Chapter were developed with local partners to demonstrate a range of examples where cities have radically transformed their streets. Other examples of best practices are spread throughout the guide.

Input from over 40 countries and 70 cities around the world was collected by an international production team working with global consultants and a specially created Global Expert Contributor Network.

The case studies numbered on the map below provide a glimpse of innovative street projects of varying types and scales.



1. Abu Dhabi, UAE
2. Amsterdam, The Netherlands
3. Auckland, New Zealand
4. Bangalore, India
5. Bangkok, Thailand
6. Bogotá, Colombia
7. Brussels, Belgium
8. Buenos Aires, Argentina
9. Cape Town, South Africa
10. Chennai, India
11. Copenhagen, Denmark
12. Delhi, India
13. Fortaleza, Brazil
14 Glasgow, UK
15. Gothenburg, Sweden
16. Guangzhou, China
17. Gurgaon, India
18. Hangzhou, China
19. Istanbul, Turkey
20. Jakarta, Indonesia
21. Jerusalem, Israel
22. Lima, Peru
23. London, UK
24. Madrid, Spain
25. Malmo, Sweden
26. Melbourne, Australia
27. Medellín, Colombia
28. Mexico City, Mexico
29. Moscow, Russia
30. Milan, Italy
31. Nairobi, Kenya
32. New York City, USA
33. Paris, France
34. Paso Robles, USA
35. Prishtina, Kosovo
36. Puebla, Mexico
37. Reggio Emilia, Italy
38. San Francisco, USA
39. São Paulo, Brazil
40. Seoul, South Korea
41. Singapore, Singapore
42. Stockholm, Sweden
43. Sydney, Australia
44. Toronto, Canada
45. Utrecht, The Netherlands
46. Yokohama, Japan
47. Zaanstad, The Netherlands

A New Approach to Street Design

A new approach to street design, based on people and place, demonstrates the possible transformation of existing streets into great urban places.

Streets are catalysts for urban transformation. The *Global Street Design Guide* presents techniques and strategies currently being pioneered by the world's foremost urban designers and engineers.

The guide is based on the principle that streets are public spaces for people as well as corridors for movement, marking a shift away from a functional classification of streets categorized only according to their ability to move traffic and provide vehicular access. Instead, it embraces an approach based on local context, the needs of multiple users, and larger social, economic, and environmental goals.

Place

Examine how the built, natural, social, cultural, and economic context of a street defines the physical scale and character of the space. Look at how the surrounding land uses, densities, and larger networks influence mobility and use patterns. *See 5: Designing Streets for Place.*

People

Identify the people who use a street today and quantify when and how they use it. Determine the desired breakdown of users and activities for future street conditions and ensure that the design meets these people's needs. *See 6: Designing Streets for People.*

Street Design

Impact

Urban streets should serve the demands of more people than they do today. They must be designed to support the myriad challenges cities will face in coming years, contributing to citywide goals and desired outcomes in the following areas.

- Public Health and Safety
- Quality of Life
- Environmental Sustainability
- Economic Sustainability
- Social Equity

How to Use the Guide

The *Global Street Design Guide* is intended for a diverse audience interested in different aspects of street design. Use this page to help understand what is included, navigate the information provided, and prioritize the portions that can be most helpful.

Inspire Change

- **Reveal what is possible:** Review, pick, choose, and adapt the tools and strategies that best apply to your context.
- **Question:** Ask why a current street is the way it is, and identify how the demonstrated street transformations could apply to your city.
- **Advocate:** Promote a shift in policies, updated practices, and financial support that favors sustainable street designs.

Guide Change

- **Set and align agendas:** Set citywide and regional agendas to promote and prioritize safe and sustainable streets. Align with related planning, health, development, safety, and sustainability policies, and practices.
- **Create guidelines, policies, tools, and practices:** Borrow the structure of this book and adapt it to make a local street design guide. Create a minimum quality standard providing a reference point for future projects.
- **Adopt and endorse:** Use the guide as formal guidance in your local context.
- **Set goals and targets:** Identify specific strategies to be prioritized citywide such as length of improved sidewalks, growth in cycle network, increase in dedicated transit lanes, number of new trees, or safety statistics.
- **Inform policies:** Support the implementation of performance-driven transportation, safety, and environmental policies.
- **Implement projects:** Realize visions of future street designs with technical detail.

Measure and Communicate Change

- **Test:** Apply design tools to create temporary or interim projects that demonstrate new possibilities.
- **Build evidence:** Document and evaluate street projects before and after implementation. Contribute to a collective global body of evidence by keeping us informed of your progress.
- **Train and educate:** Train professionals, educate practitioners, and run community workshops on the design and implementation of streets.
- **Communicate priorities:** Provide a clear sense of direction to the stakeholders who shape streets and support the case for design changes.

Navigation

Use the tabs at the top of the page to navigate the section, chapter, and sub-chapter of each page.

Chapter Name
Section Title
Sub-Section Title

Chapter Name
Section Title
Sub-Section Title

Chapter Name
Section Title
Sub-Section Title

A
About Streets

Chapters 1-3

Understand why streets matter, learn about the processes involved in shaping and implementing great street projects, envision what is possible, and identify what to measure in order to build community and political support for future projects.

B
Street Design Guidance

Chapters 4-9

Recognize the importance of considering context and culture in the design of streets for place. Identify the different groups of people using the street and use the design strategies presented to meet their needs. Use the Management and Operations chapter to assist in managing streets in space and time, and the Design Controls chapter to actively set the parameters for great street designs in the future.

C
Street Transformations

Chapters 10-11

Identify possible reconfigurations of a variety of street and intersection types, and learn from the case studies of how other cities have transformed their streets.

Designing Streets for People

Use the icon tabs in chapter 6 to find the design guidance for specific users. Identify these users across the guide using these icons and their respective colors.


Pedestrians


Cyclists


Transit Riders


Motorists


Freight Operators and Service Providers

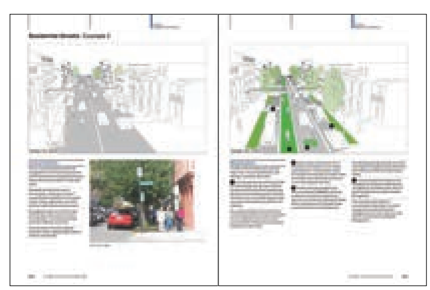

People doing Business

Highlights

Street elements and design guidance are called out by way of highlighting the design feature using a yellow color.

Before and After Transformations

All street and intersection transformations in Section C are designed as spreads with a before and after 3D model on the left page and right page respectively.



Dimension Conversion

See Appendix A: Conversion Chart to find a complete set of conversions for key dimensions under various units of measurement used in the guide such as:

- Distance (1 m = 3.3 ft)
- Speed (1 km/h = 0.62 m/h)

A

About Streets


UE STATION
白沙道2A地下
永亨信用財務
譽
UNIQUE
TIMEPIECES
喜運佳 · 譽一鐘表
池記
雲吞麵
足清亭
136
CHINADAILY
Happy Valley
跑馬地
上海
N2

1

Defining Streets

With 75% of the world's population expected to be living in cities by the year 2050, urban streets will need to balance demands for increasing personal mobility and access to the city economy. Where the low-density, auto-centric development patterns of the 20th century have failed, dense cities with robust multimodal transportation networks are best suited to provide sustainable growth, equal economic opportunity, and a high quality of life. Walkable, cyclable, and transit-oriented neighborhoods are what today's urban dwellers need and demand.

The capacity of urban streets must be increased in ways that support the urban context and ensure a high-quality public realm. This can be achieved by prioritizing sustainable modes of transportation through dedicated space, allowing high-efficiency modes like transit to leave more room for other street activities that support urban life.

As cities grow upward, inward, and outward to serve changing populations, it is critical to consider the many players and processes that shape streets. Our streets are integrally tied to other urban systems, and designing them well offers multiple benefits to cities and their residents.

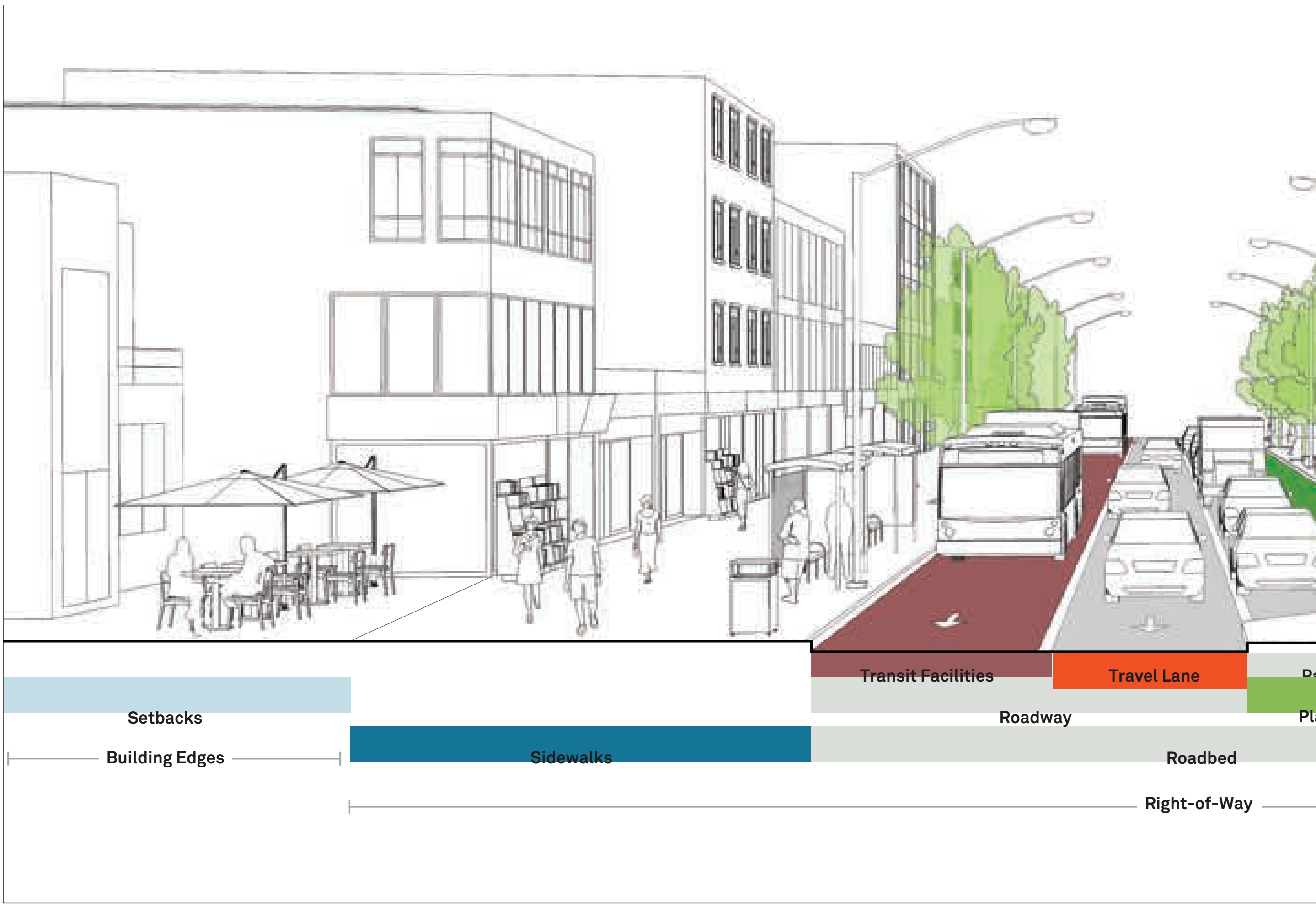
Hong Kong, China

1.1 | What is a Street

A street is the basic unit of urban space through which people experience a city. It is often misconceived as the two-dimensional surface that vehicles drive on when moving from one place to another. Streets are, in fact, multidimensional spaces consisting of many surfaces and structures. They stretch from one property line to another, including the building edges, land uses, and setbacks that define each side. They offer space for movement and access and facilitate a variety of uses and activities. Streets are dynamic spaces that adapt over time to support environmental sustainability, public health, economic activity, and cultural significance.

Streets are like outdoor rooms shaped by multiple planes: the ground plane at the bottom, the buildings and the roadbed edges as the side planes, and the canopy plane like the ceiling of the room. Each plane is constructed of many individual elements that are often regulated or created by a range of different policies, codes, guidelines, and building practices.

Understanding the various portions of a street as either continuous or interchangeable offers a flexible approach to street design. While sidewalk clear paths, bike lanes, and travel lanes must be continuous and connected in order to function effectively, interchangeable elements such as parking spaces, trees, parklets, and transit stops allow a street to be adapted to serve its context. The terms below broaden the definition of *street*.



Right–of–Way

The entire distance from building edge to building edge.

Sidewalk

Dedicated space with clear walking paths and universal access used for a variety of activities and functions. *See 6.3.4: Sidewalks.*

Roadbed

The space between the two sidewalks that can be designed to carry various modes of transportation and their ancillary facilities.

Transit Facilities

Dedicated space within the roadbed for different types of transit to travel on. *See 6.5.4: Transit Facilities.*

Service Infrastructure

The utilities and services provided within the space of the right-of-way.

Street Activity

Social interactions, neighborhood activities, and citywide events that take place within the street.

Street Furniture

The objects, elements, and structures placed within the street.

Building Edges

The collection of building facades, windows, setbacks, signs, and awnings that define each side of the street.

Travel Lanes

The dedicated space within the roadbed for motorized vehicles to move on. *See 6.6.4: Travel Lanes.*

Ancillary Lanes

Dedicated spaces for stationery cars, cycles, transit vehicles, loading and unloading zones.

Cycle Facilities

Dedicated space for cyclists to travel. This can be within or separate from the roadbed. *See 6.4.4: Cycle Facilities.*

Planting

Trees, planting beds, and green infrastructure within the sidewalk, between parking spaces, or in medians. *See 7.2: Green Infrastructure.*

1.2 | Shifting the Measure of Success

After decades of designing streets to move large numbers of vehicles as efficiently as possible, cities are finally rediscovering the benefits of designing safe and livable streets that balance the needs of all users. It is time to change practices and redefine what constitutes successful streets. Streets should not be evaluated in isolation or as transportation projects alone. Instead, each design presents an opportunity to ask what overall benefits can be gained.

Public Health and Safety

Every year, millions of people die unnecessarily from preventable causes, such as traffic violence or chronic diseases related to poor air quality and lack of physical activity. Street design must promote safe environments for all users and offer healthy choices that facilitate active transportation, such as walking, cycling, and using public transit. Streets should improve access to healthy food options, mitigate noise levels, and provide landscaping and trees that improve air and water quality.

Quality of Life

Cities around the world are competing for the title of 'most livable city'—a recent measure of success—acknowledging the value of quality-of-life measures in attracting and retaining residents and businesses. As people experience a city through its public spaces, the livability of a city is highly dependent on its streets. Shaping how safe, comfortable, efficient, and vibrant a city's streets are will affect how livable it is and how connected its citizens feel. Streets can encourage social interaction, and designs that offer natural surveillance and help build stronger, safer communities.[1]

Environmental Sustainability

In the face of unprecedented climate challenges, street projects provide an opportunity for local actions to improve the environmental sustainability and resilience of a city. Promoting sustainable transportation modes through well-designed streets can lower carbon emissions and improve overall air quality. Incorporating trees and landscaping can improve water management, foster biodiversity, and increase access to the natural environment.

Economic Sustainability

Great streets attract people and business. Street projects that increase safety, improve public realm quality, and welcome multimodal use have positive economic effects such as higher retail sales and increased property values. Investment in streets has long-term economic benefits.[2]

Social Equity

In an era of increasing inequality, cities must ensure that their most valuable public spaces offer safe and equitable use to all, regardless of ability, age, or income, empowering the most vulnerable users with safe and reliable mobility choices.

A city serves its citizens better through street design that increases access to jobs and schools, benefits individual health, improves sanitation, and encourages strong communities.

1.3 | The Economy of Streets

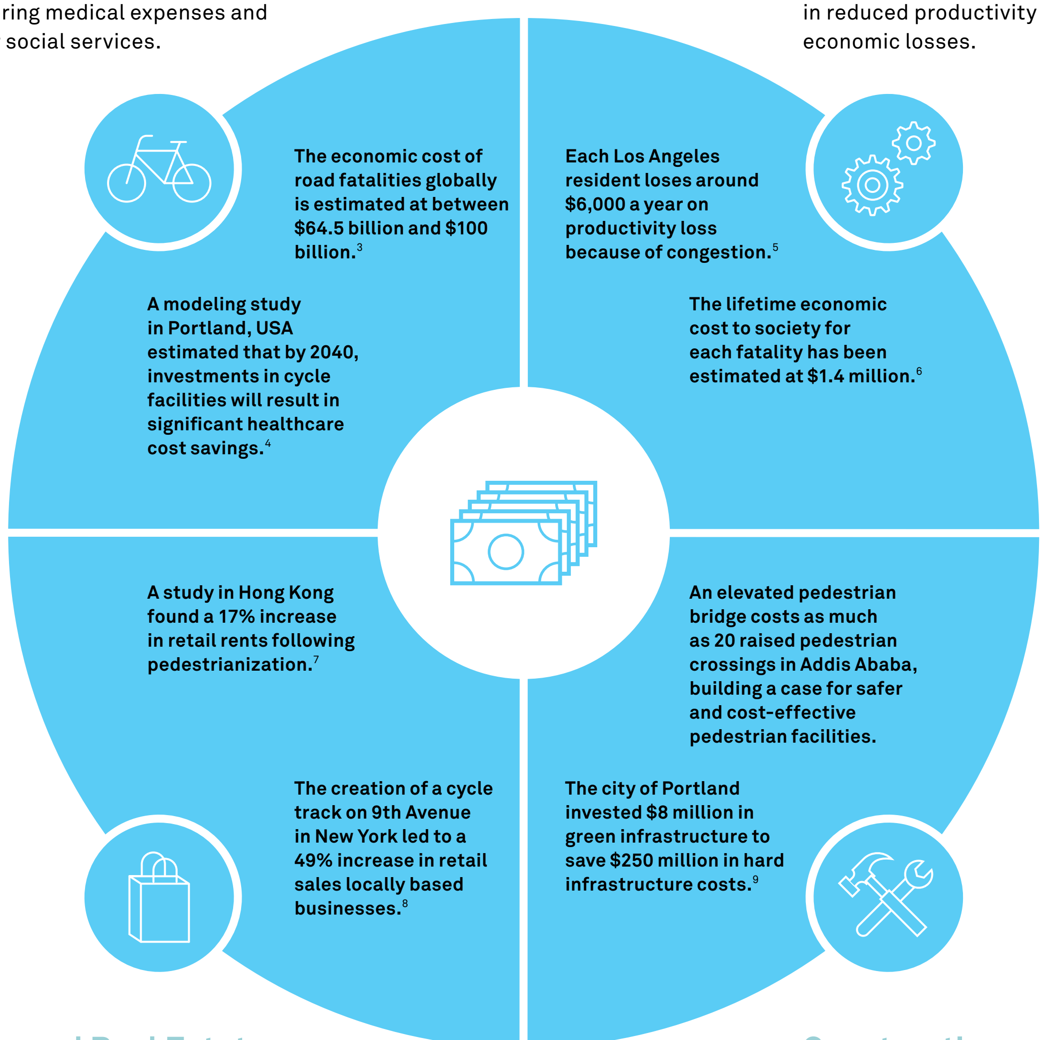
A safe, vibrant, efficient street network is essential to the economic health of a city or region. Street design also plays a major role in facilitating access to formal and informal commerce, jobs, or the wholesale movement of goods. The up-front costs of constructing a street should be considered with regard to the benefits its design will confer throughout its lifespan. Cost impacts of street design should be considered for individuals through value of travel time, public transportation access, fuel costs, and individual health, while the larger externalized cost to society can be examined through expenses such as those related to traffic crashes, hospital costs, negative environmental impacts, and congestion.

Health and Human Lives

The cost of lives lost and serious injuries caused by road crashes have a significant impact on the economy. Better-designed streets relieve mental and physical stress, lowering medical expenses and the need for social services.

Work and Productivity

Significant numbers of human working hours are lost as a result of time spent in congestion or injuries incurred in road crashes. These lost hours result in reduced productivity and, therefore, economic losses.



Business and Real Estate

Pedestrians, cyclists, and transit riders generally spend more money at local retail businesses than people who drive cars, underscoring the importance of offering attractive, safe spaces for transit riders, pedestrians, and cyclists. Great streets have also been shown to add value to neighborhoods.

Construction and Maintenance

Narrow streets cost less to build and maintain. Using good-quality, durable materials can significantly reduce maintenance costs. Green alleys or streets and tree planting are estimated to be 3-6 times more effective in managing stormwater and reduce hard infrastructure cost.[10]

1.4 | Streets for Environmental Sustainability

Designing streets that respond to their environment can help cities meet the challenges of a warming planet. Various international organizations and agendas, such as the UN Sustainable Development Goals, have increased the focus on environmental sustainability, greenhouse gas emissions, and global warming. It is the time to promote the environmental benefits of great streets. Investment in sustainable streets can be attracted by highlighting improved environmental impacts and increased contribution toward achieving a city's environmental goals.

Microclimate

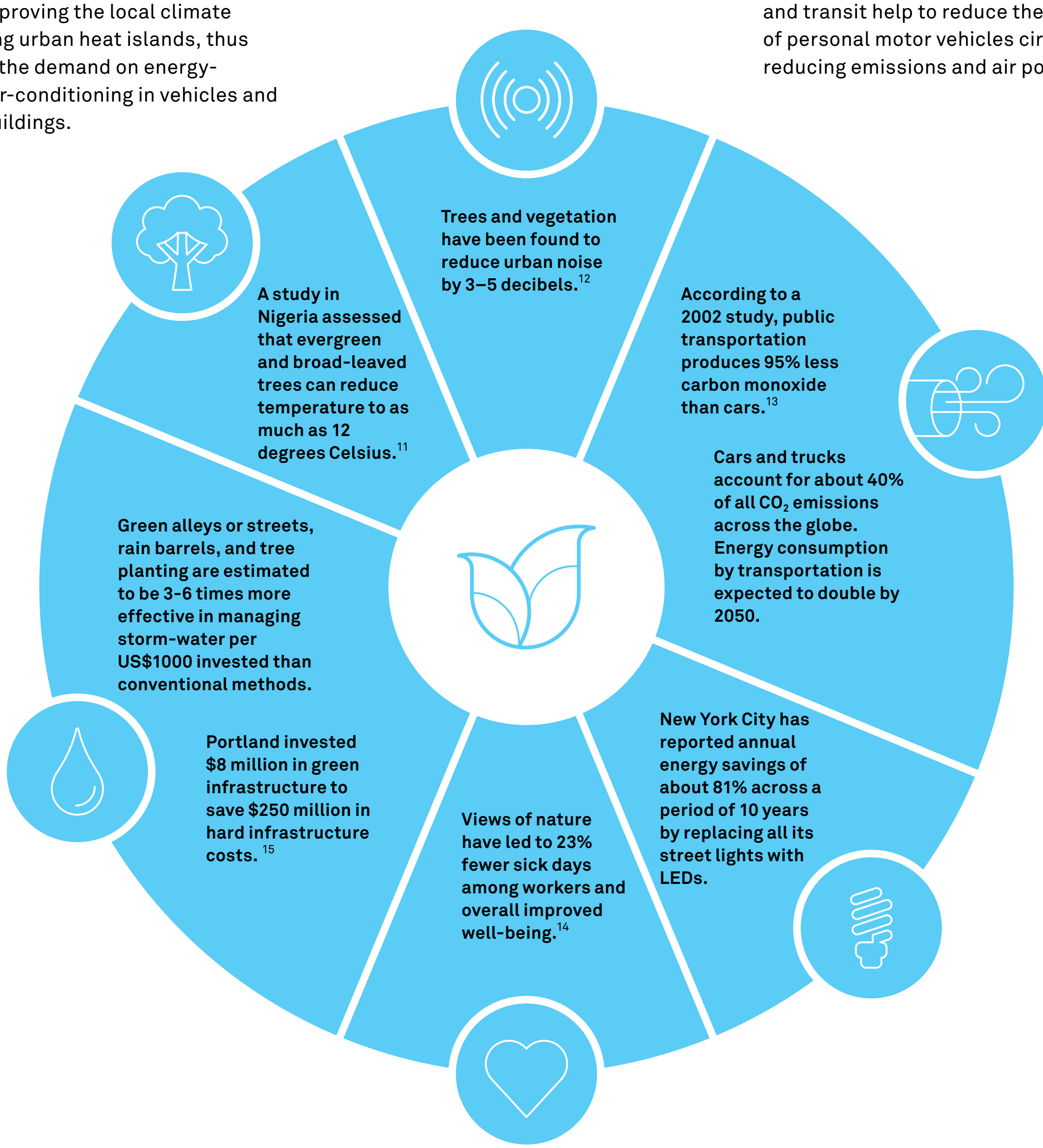
Street trees and landscaping can assist in improving the local climate and reducing urban heat islands, thus minimizing the demand on energy-intensive air-conditioning in vehicles and adjacent buildings.

Noise

Urban trees can reduce noise pollution.

Air Quality

Streets prioritizing pedestrians, cyclists, and transit help to reduce the number of personal motor vehicles circulating , reducing emissions and air pollution.



Water Management

Incorporating green infrastructure strategies and local plant species within streets helps manage stormwater and reduces irrigation needs. *See 7: Utilities and Infrastructure.*

Health and Safety

Urban trees and vegetation help decrease stress and aggressive behavior in cities[16] and have been linked to crime reduction.[17]

Energy Efficiency

Street projects can contribute to improving a city's energy and resource efficiency by using recycled and low-impact materials and technologies as well as renewable energies.

1.5 | Safe Streets Save Lives

More than 1.2 million people die on roads around the world every year. That is equivalent to roughly one person dying every 30 seconds, or over 3,400 people dying every single day of the year.[18] Many of these deaths occur on urban roads and are preventable crashes caused by behavior induced by street design.

Creating safe streets is a critical responsibility shared by designers, engineers, regulators, and civic leaders. Even in the cities with the best safety records, the threat of traffic violence makes movement around the city a potentially dangerous daily activity. Highway-like street designs that prioritize automobiles over vulnerable users and encourage high speeds fail to provide safe environments.

A New Paradigm for Safety

The new paradigm for safety is built on human limits. The human body is fragile and can only survive certain forces. This means:

- Reducing exposure to the risk of conflict
- Reduce crash numbers and the severity of impact by
- Reducing speed
- Shaping streets that are safe for vulnerable users

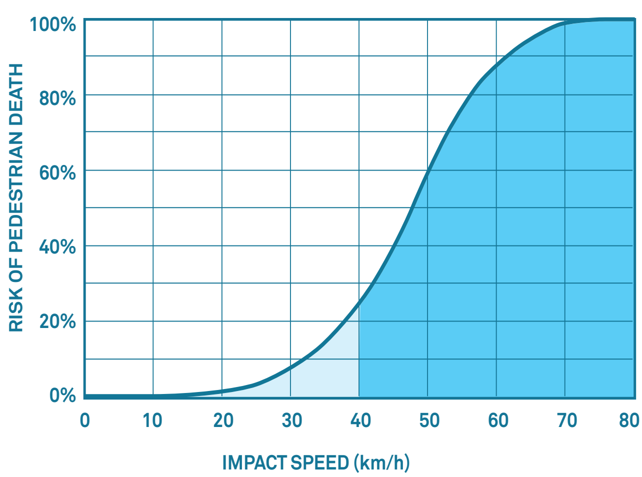
When vehicles move at or below 40 km/h, potential conflicts take place at lower speeds, dramatically increasing the chances of survival in the case of a crash.

Studies from around the globe have shown that most traffic deaths, especially the easily preventable pedestrian deaths, occur on a small percentage of arterial streets.[19] These streets are rendered dangerous by design. They contain the following characteristics:

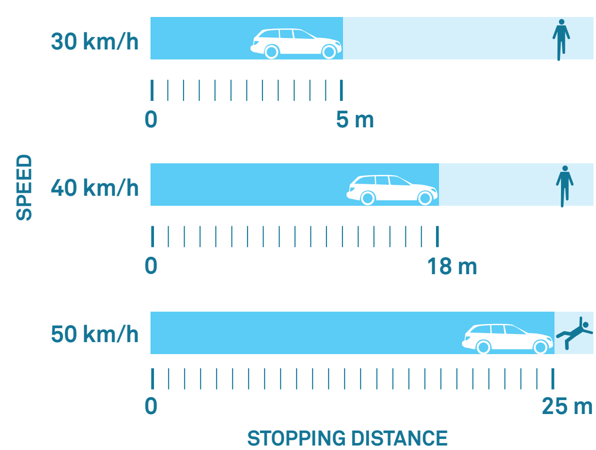
- Wide streets that invite speeding and lack safe crossings.
- Streets that act as front yards but allow aggressive behavior by those passing through.
- Highway-like surface streets where motorcyclists and public transport passengers are at risk from large speed differentials, and where sidewalks are missing or substandard.

The combination of high traffic speeds and volumes, long crossings, and large distances between marked crossings make them fatal corridors for vulnerable users.

Speed is the single most important factor in the safety of a street, and is directly proportional to the risk of pedestrian fatality in cases of conflict.



The relationship between impact speed and risk of pedestrian death. Several recent studies (Pasanen 1993, DETR 1998, Rosen and Sanders 2009, and Tefft 2011) show the existence of a clear relationship between vehicular speeds and pedestrian casualties, supporting the idea that speeds over 40 km/h should not be permitted in urban streets. However, most of these studies were conducted in high-income countries and there are reasons to believe this relationship might be even more extreme in low- and middle-income countries.[20]



The relationship between speed and stopping distance. The graphic above depicts minimum stopping distances, including perception, reaction, and braking times. They are based on dry conditions and assume perfect visibility.[21]

Common Causes of Traffic Fatalities

Many traffic injuries are directly related to design. Conditions become more dangerous with the addition of speed. Common causes for traffic fatalities include the following:

- **Lack of Sidewalks:** When the sidewalk is blocked, narrow, or nonexistent, pedestrians are forced into the roadbed. This presents a particular threat when the street is designed for fast-moving vehicles, and not designed to accommodate all users safely.
- **Lack of Accessible Crossings:** Pedestrians are at risk of being struck when accessible crossings are not provided or are inaccessible. Mid-block pedestrian crashes are very common on large streets, where vehicle volumes and speeds are prioritized over sufficient opportunities for safe crossing.
- **Lack of Protection:** Wide, multi-lane streets without refuge spaces expose pedestrians to moving vehicles for longer distances as they cross the street. This is particularly unsafe for the elderly or those who move at a slower pace.
- **Lack of Predictability:** When signals and countdown clocks are not provided, or when signal cycle lengths result in a long wait time, pedestrians are unable to safely judge the time they have and are more likely to cross unsafely.
- **Lack of Cycle Facilities:** Cyclists are at risk of rear-end and overtaking crashes when mixing with motor vehicles at moderately high speeds, especially on multi-lane streets.
- **Poor Intersection Design:** Large intersections are often designed for dangerous, high-speed turning. Lack of visibility results in poor navigation and assessment of different users' movements.
- **Unsafe Boarding Areas:** Transit riders are at risk when boarding and alighting vehicles in traffic, especially if no safe facilities are provided. Higher-speed streets and poor intersection design near boarding areas increase chances for severe crashes and put vulnerable users at risk.
- **Surface Hazards:** Obstacles and surface degradation, including potholes, can present hazards to pedestrians and cyclists.

Safe Design Supports Education and Enforcement

Regulations and education are critical to creating a culture of safety. However, a street cannot be made safe if it has been designed to prevent people from making safe decisions. Most road safety agendas focus on reducing probability of human error through education and enforcement, without emphasizing the design of safe streets. Design can ensure that a crash or conflict caused by human error will be limited in its severity. The design of a street is often far outside the scope of a safety project, but it can have direct and indirect impact on the safety of street users.

Vision Zero and Sustainable Safety Programs

The Vision Zero (initiated in Sweden) and Sustainable Safety (initiated in the Netherlands) programs are proactive safety programs being adopted by an increasing number of cities around the world. The premise of such programs is that loss of life is unacceptable, and their goal is preventing all serious road crashes. These initiatives place the burden of safety on the system design, not the road user. Innovative street designs that reduce speed, strict enforcement against traffic violations, legislative ordinances that lower speed limits, and public awareness campaigns have proven to be impactful strategies adopted by these programs.

According to the World Health Organization, over 3,400 people die on the world's roads every day and tens of millions of people are injured or disabled every year. Children, pedestrians, cyclists, and older people are among the most vulnerable of road users.

1.6 | Streets Shape People

Human Health

The World Health Organization defines health as a state of complete physical, mental, and social well-being (and not merely the absence of disease). Urban streets provide the platform for everyday experiences and must, therefore, be designed to support human health and well-being for all people.

Traffic Fatality and Injury

In addition to the 1.2 million people who die, another 20–50 million people are seriously injured each year as a result of road traffic crashes. Young adults aged between 15 and 44 years account for 59% of global road traffic deaths.[22]

Air Quality

Outdoor air pollutants are a major public health concern, causing respiratory and other diseases. An estimated 3.7 million deaths worldwide in 2012 were caused by air pollution and 88% of these deaths were in low- and middle-income countries.[23] Policies and investments in streets that support cleaner, low-emission transportation choices such as collective transit, walking, and cycling can assist in reducing outdoor air pollution.

Physical Activity

Insufficient physical activity is one of the ten leading risk factors for death across all income scales worldwide and a key risk factor in non-communicable diseases. With more than 80% of the world's adolescent population insufficiently physically active,[24] streets must offer safe and accessible sidewalks and cycle facilities to promote physically active modes of transportation.

Water Stagnation

Water stagnation exposes people to water-borne and vector-borne diseases. Streets designed for easy maintenance and proper water flow management reduce the chances for water stagnation, thereby reducing the risk of water-borne diseases.

Access to Nature

Streets are public spaces that people use on a daily basis. Providing access to nature with street trees and landscaping can reduce blood pressure and improve emotional and psychological health.[25]

Noise Pollution

Street noise is one of the primary sources of noise pollution, contributing to a number of health problems, such as sleep disturbance, cardiovascular issues, poor work and school performance, and hearing impairment. Allowing large vehicles and heavy traffic on residential streets may cause sleep disturbances. Street design can reduce speed while policies can reduce horn use, minimizing noise pollution, and reducing discomfort for other street users.

Human Experience

Human experience of neighborhoods and cities is shaped by streets. The ease at which people move from one place to another, access services, enjoy their surroundings, and feel safe impacts their mental health and comfort.

Human Senses

The most intimate experience of a street comes from walking on the sidewalk, suggesting that the success of the street should be measured at human eye level, and at walking speed. Pedestrians experience the street with all their senses. Smells, sounds, textures, and visual interest shape the comfort of the space. Young children, whose senses are not yet fully developed, will use and experience a street differently. As people age, their hearing, vision, and mobility may become impaired, changing the way they receive signals from their environment and their ability to use the street. Consider how textures, materials, sounds, and visual clues can create a safe and enticing environment for people of all abilities.

Safety and Access

People feel more comfortable using safe streets. Urban streets must be designed for slower traffic speeds and include sidewalks, lighting, furniture, and shade to support a safe experience. Streets provide links to critical services such as health care and education and require safe, secure, and accessible routes. Street design should provide spaces that enhance urban safety and support crime prevention.

Social Interaction

Well-designed streets connect people with their communities, providing opportunities to meet people, see friends, and feel socially connected. Streets with reduced traffic volumes and speeds extend the territory of the private spaces that line the street, increasing the opportunity for social interaction.

Empowerment and Social Inclusion

Streets should be spaces of empowerment for the vulnerable. For people burdened with poverty or living in cultures that face social inclusion challenges, streets should provide an inclusive place for diverse users.[26]

Expression

As the central network of public space in a city, streets are often places for political or cultural expression, demonstrated through parades, marches, and celebrations. Streets should be designed as neutral ground to support such events.

Spiritual and Personal Meaning

As sites for daily activities and rituals, streets hold memories of places and events. Streets can represent the character of a specific place and have personal meaning to people. Street design should support safe, positive, and enjoyable experiences.

1.7 | Multimodal Streets Serve More People

Great street designs move, hold, and serve more people within the same space.

Streets must be designed to serve different modes and provide multiple mobility options for its users.

Multimodal streets offer people options for safe, attractive, and convenient travel by foot, by cycle, on transit, as well as in motorized vehicles.

Multimodal streets help to make cities more efficient. A reduction of private cars on streets has a direct link to reduced production of greenhouse gases, related to climate change. This shift also helps in increasing space for commerce and public use, and contributes to a better quality of life and economic growth.

Multimodal Streets Move More People

Multimodal streets move more people. Repurposing street space for more efficient travel modes increases the total street capacity while reducing personal motorized vehicles.

This reduces time spent commuting, thereby increasing productive time that contributes to economic growth.

Multimodal Streets Support Local Businesses

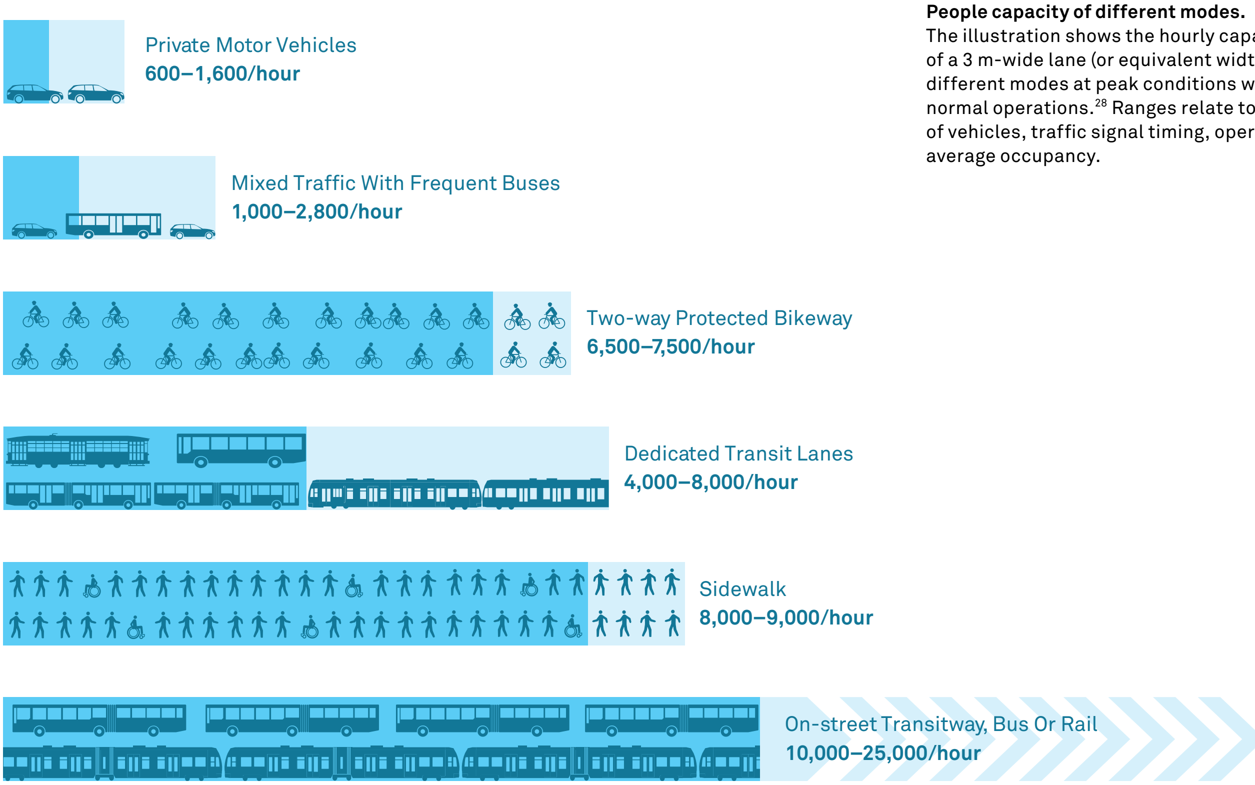
Street projects that improve safety and encourage multimodal use have positive economic effects, such as higher retail sales and improved property values.[27] Moreover, people who walk or cycle often spend more at local retail businesses than people who come to an area by car, underscoring the economic importance of offering attractive, safe spaces for transit riders, pedestrians, and cyclists.

Multimodal Streets are Accessible to More People

A multimodal street network allows people to tailor their trip by their preferred mode of travel. Multimodal streets provide better accessibility to locations within the citywide transit and cycling networks, which can enhance the adjoining neighborhoods and improve property values. This can help invite new businesses and services to improve the overall quality of life.

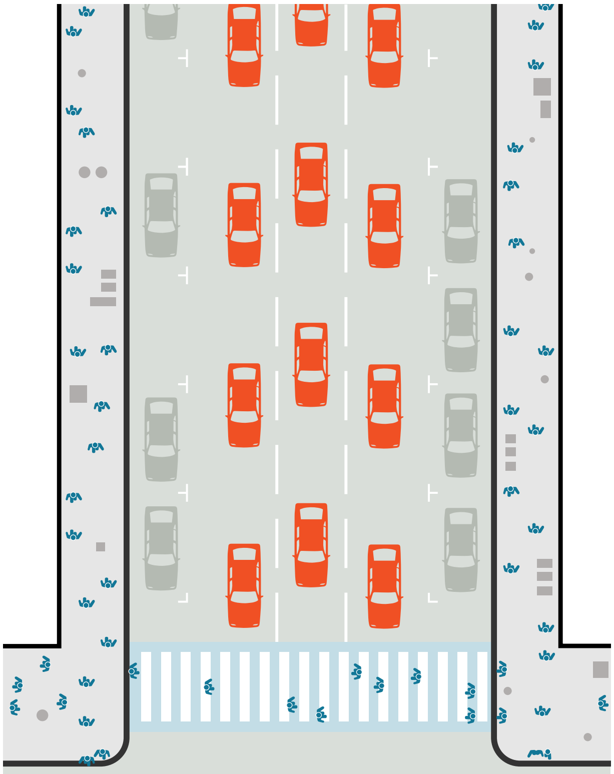
Multimodal Streets are More Environmentally Sustainable

Multimodal streets provide infrastructure for sustainable modes like walking and cycling, which can help lower carbon emissions by reducing vehicular exhaust, thereby improving overall air quality and reducing a city's contribution to climate change.

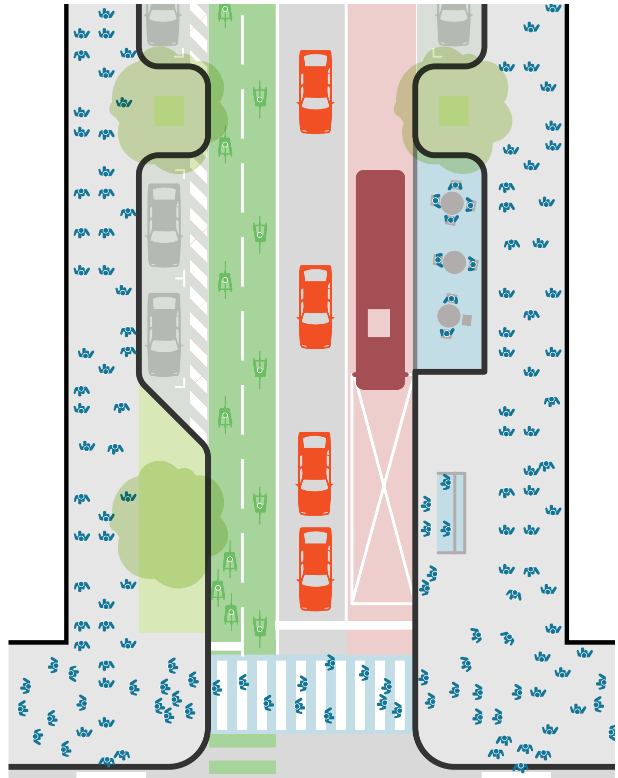


People capacity of different modes. The illustration shows the hourly capacity of a 3 m-wide lane (or equivalent width) by different modes at peak conditions with normal operations.[28] Ranges relate to the type of vehicles, traffic signal timing, operation, and average occupancy.

Car-Oriented Street



Multimodal Street



The capacity of car-oriented streets and multimodal streets. These two diagrams illustrate the potential capacity of the same street space when designed in two different ways. In the first example, the majority of the space is allocated to personal motor vehicles, either moving or parked. Sidewalks accommodate utility poles, street light poles and street furniture narrowing the clear path to less than 3 m, which reduces its capacity.

In the multimodal street, the capacity of the street is increased by a more balanced allocation of space between the modes. This redistribution of space allows for a variety of non-mobility activities such as seating and resting areas, bus stops, as well as trees, planting and other green infrastructure strategies. The illustrations show the capacity for a 3-m wide lane (or equivalent width) by different mode at peak conditions with normal operations.

Hourly Capacity of a Car-Oriented Street

4,500/h	x2	**9,000 people/h**
1,100/h	x3	**3,300 people/h**
0	x2	**0 people/h**

Total capacity: 12,300 people/h

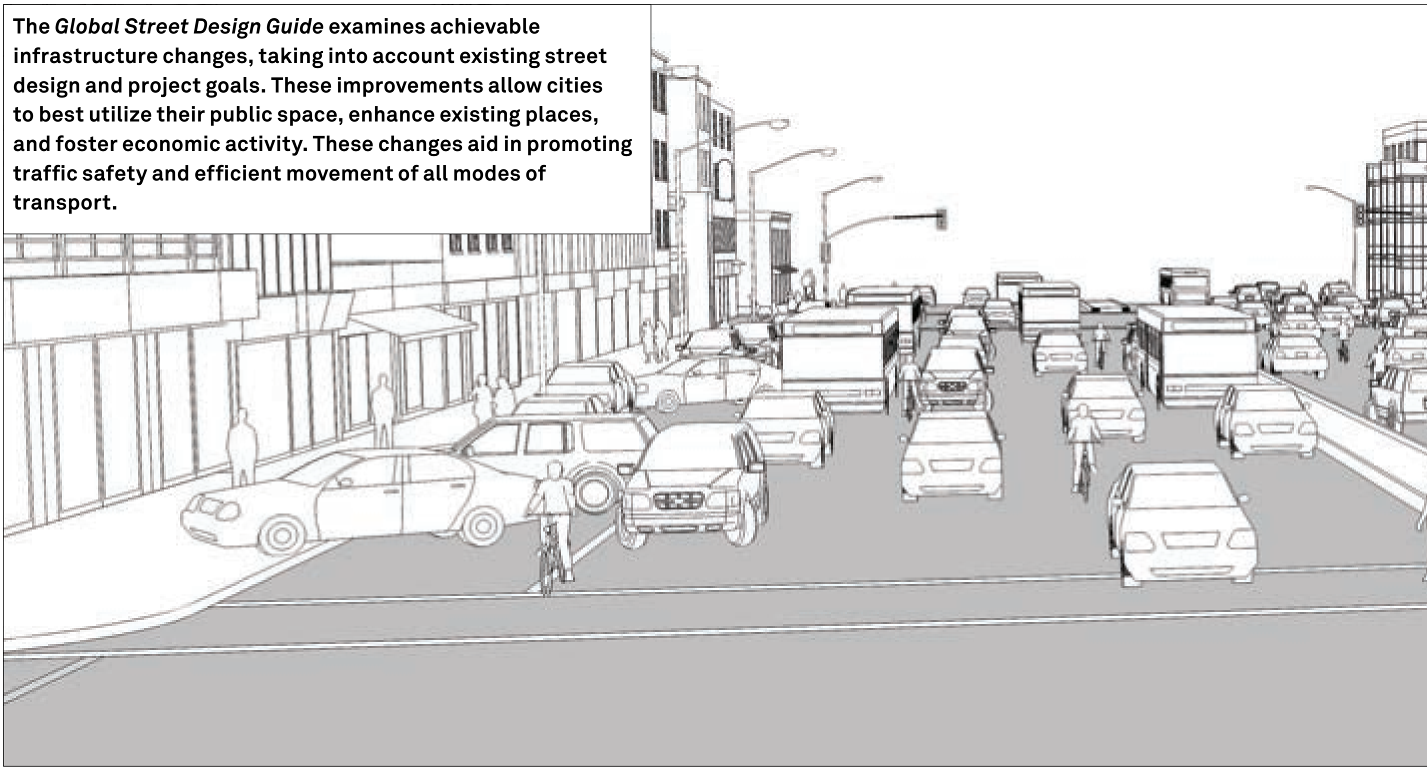
Hourly Capacity of a Multimodal Street

8,000/h	x2	**16,000 people/h**
7,000/h	x1	**7,000 people/h**
6,000/h	x1	**6,000 people/h**
1,100/h	x1	**1,100 people/h**
0	x1	**0 people**

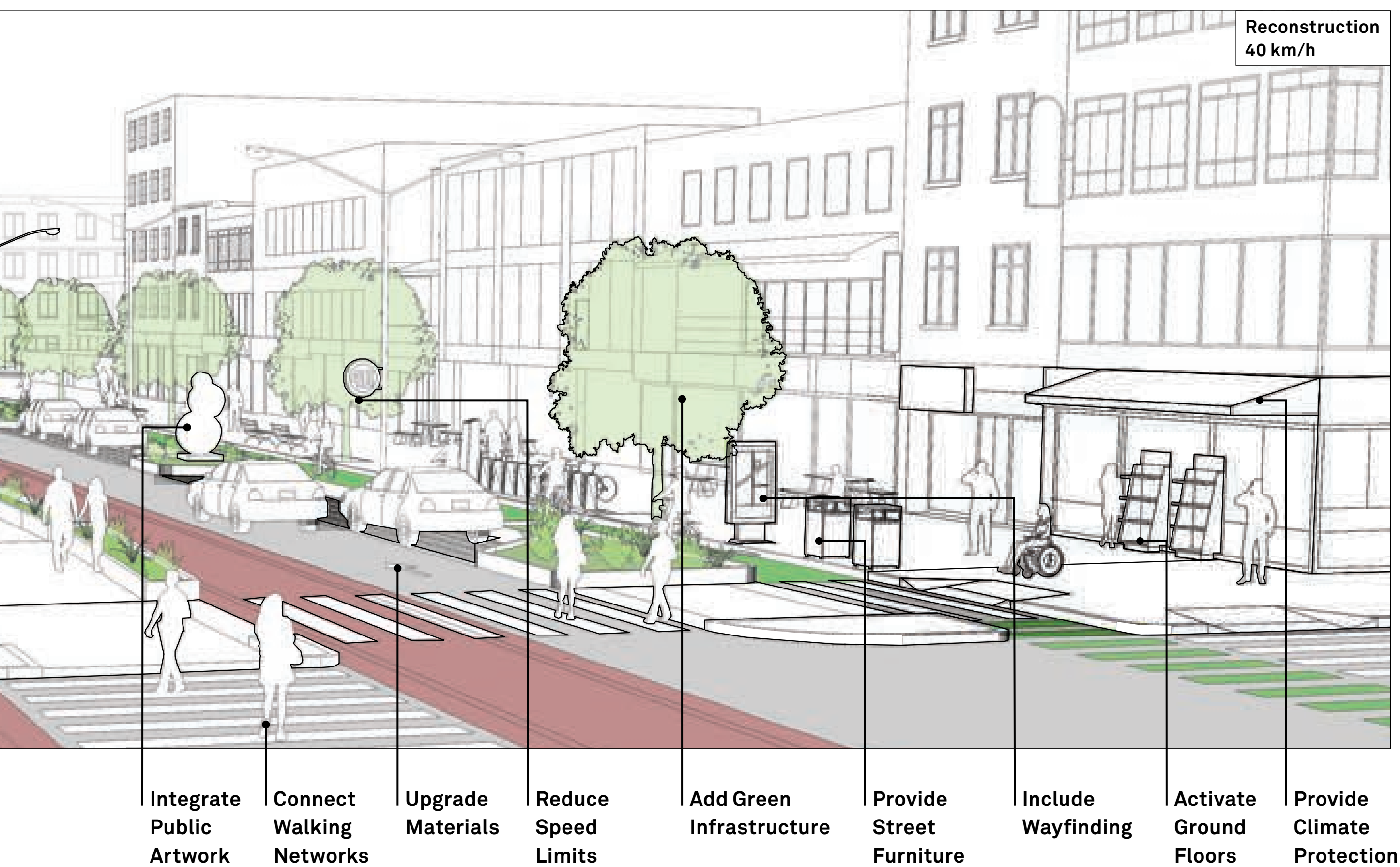
Total capacity: 30,100 people/h[29]

1.8 | What is Possible

The *Global Street Design Guide* examines achievable infrastructure changes, taking into account existing street design and project goals. These improvements allow cities to best utilize their public space, enhance existing places, and foster economic activity. These changes aid in promoting traffic safety and efficient movement of all modes of transport.




Existing
60 km/h


Reconstruction
40 km/h
Integrate Public Artwork
Connect Walking Networks
Upgrade Materials
Reduce Speed Limits
Add Green Infrastructure
Provide Street Furniture
Include Wayfinding
Activate Ground Floors
Provide Climate Protection


NO
ENTRY
AREA 501 PERMIT
HOLDERS EXCEPTED
MID NIGHT - 7 AM
9 30 AM - 4 PM
7 PM - MID NIGHT
BICYCLES EXCEPTED
AT ALL TIMES
Bank of Melbourne

2

Shaping Streets

Multiple agencies play a role in the various aspects of shaping streets. The blueprint of urban streets is informed by many stakeholders, from creating broad visions and policy agendas, providing local insights, or developing detailed plans and geometric designs. The lifespan of the street depends on well-coordinated project management, quality construction practices, and ongoing maintenance. Ensuring sustainable streets for coming generations is dependent on embedding change, updating policies, and educating future practitioners.

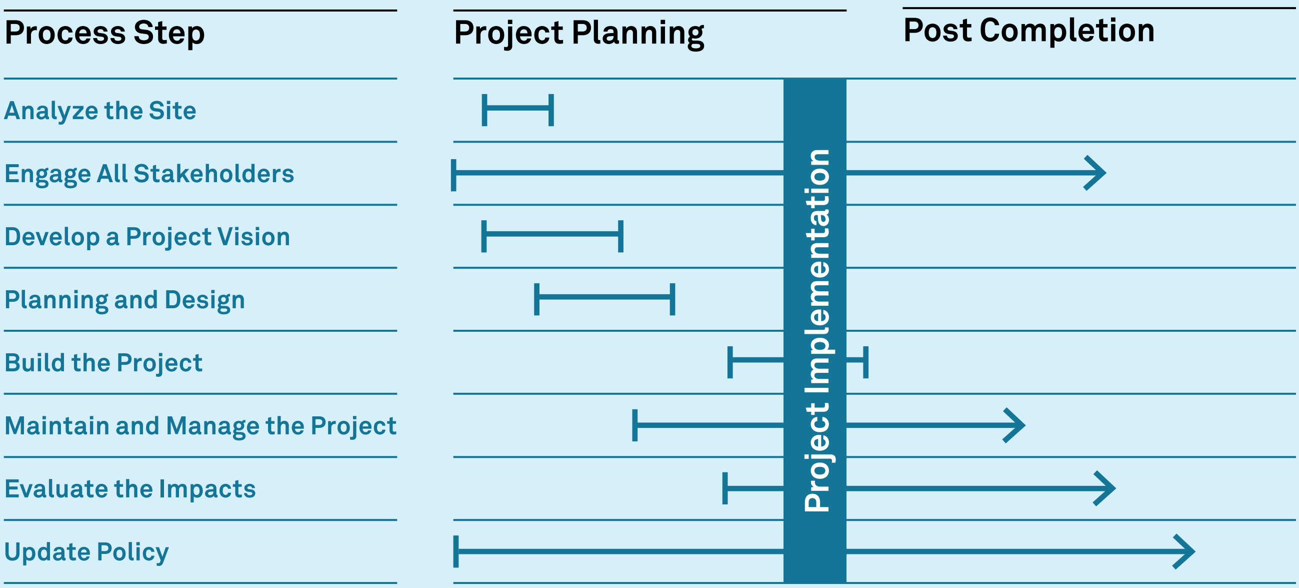
Identify the specific steps of the process in each local context, and engage with relevant stakeholders to clarify responsibilities and opportunities for shaping quality and equitable streets.

Melbourne, Australia

2.1 | The Process of Shaping Streets

A TYPICAL PROCESS FOR SHAPING STREETS

While local processes vary in each context, use the typical steps in the diagram below to define and guide the process for each project before it begins. Street design is an iterative process. Processes should remain flexible and relevant, evolving and adapting over time as best practices, specific challenges, and contexts change. Use the following steps to guide the process of shaping streets.



While specific processes vary by place, coordination and collaboration during each stage is fundamental, and effective communication and engagement throughout the process is critical.

Analyze the Site

Start by analyzing and documenting the physical, social, and environmental context of the project site. Consider multiple scales of the street to identify how it functions as a part of its immediate surroundings and within larger network connections. Document existing infrastructure that will affect the street design. Observe who uses the street and at what time, and note the various activities. Analyze who lives and works in the area, while observing local customs, cultures, and political influences. Check legal and guiding documents in the city and region for specific goals or agendas that relate to the project site. Once the existing conditions are thoroughly observed and documented, identify and prioritize primary challenges and needs to discuss with the project stakeholders.
See 3: Measuring and Evaluating Streets and 5: Designing Streets for Place.

Engage All Stakeholders

Identify and invite all stakeholders to engage in the process of shaping their streets to ensure long-term success and stewardship. Constituents are more likely to be supportive of a project if they have been a part of the process of identifying the constraints and opportunities that inform the design. Work with transportation, planning, development, public health, and environmental groups to identify how street projects align with shared goals and priorities. Align project proposals with existing and upcoming utilities and service projects in the area and take this opportunity to propose the introduction of progressive technology or retrofitting of vital utilities. Nobody knows a local street better than the people who use it every day, so welcome input from local constituents to make a project more applicable to a specific context. Discuss and clarify local priorities for public health and safety, quality of life, environmental sustainability, and local economy. Make decisions together and keep all parties involved throughout the process. *See 2.5: Communication and Engagement.*

Develop a Project Vision

With a thorough understanding of the existing site conditions, various stakeholder interests, and project constraints, develop a vision for the street's look, feel, and function in the future. Identify best-practice street design strategies and innovative examples that are most applicable to the local context. Use visual renderings, drawings, and metrics to show and explain what is possible, and test ideas with local stakeholders. Ensure the project vision aligns with citywide goals and community priorities for public health and safety, quality of life, and environmental and economic sustainability. Where possible, develop a few options that balance the project constraints and stakeholder interests through different designs, including communities, in the decision-making process. *See 2.4: Setting a Project Vision.*

Planning and Design

Guide the transformation of a project vision into reality through planning and design. Ensure the proposed project is intrinsically linked to larger mobility frameworks and comprehensive planning strategies that shape sustainable transportation, land use, and density. Coordinate with relevant stakeholders to clarify budgets, timelines, and project scope. Ensure budgets not only cover the construction costs, but also account for funds to cover ongoing maintenance and management of the project. Design facilities and elements to align with functional priorities and local placemaking goals. Identify quick and easy wins, consider testing designs on site through interim solutions, and offer professional design reviews for further refinement. Ensure that local conditions, climate, ongoing maintenance, and implementation processes inform decisions about materials, design, long-term durability, and user behavior.

Build the Project

Implement great streets projects by ensuring each part of the process is well-coordinated and that selected materials and resources are available. Secure adequate finances and construct interim phases and trial projects when initial budgets are limited. Use construction drawings, training sessions, and other tools to clearly communicate each step of the process to contractors. Ensure that appropriate skilled labor, equipment, and services are arranged to support quality construction. The long-term durability of the street will be determined at this stage of the process. Consider adopting suitable local skills and materials for economic, environmental, and social benefits. *See 2.6: Costs and Budgets.*

Maintain and Manage the Project

Increase the usable lifespan of streets by ensuring ongoing maintenance and management. It is always more cost-effective to use quality materials and proactively maintain a street rather than let chronic issues develop to the point of major disrepair. Work with local businesses and constituents to provide regular maintenance and to program pedestrian-priority spaces where appropriate. *See 2.10: Management and 2.11: Maintenance.*

Evaluate the Impacts

Measure and communicate the impacts of a completed street transformation. Use metrics to convey information to decision makers and community members. Collect metrics before and after implementation to inform future design approaches and assist in building political and community support for other projects. Encourage stakeholders to agree on the right metrics to be collected early in the process, and use the results to benchmark the project against prior conditions, other local streets projects, citywide data, or national and international projects. *See 3: Measuring and Evaluating Streets.*

Update Policy

Use the outcome of the evaluation to update local policies and guidelines. Develop new policies to support sustainable streets if they do not already exist. Ensure local codes and practices are revisited every few years to test their relevance rather than base policies on outdated best practices. Identify impediments and challenges to implementing contemporary approaches. Base policies on the most recent documents, relevant precedents, and research available. Base policy on the desired future conditions—not on projections of past trends. *See 2.12: Institutionalizing Change.*

2.2 | Aligning with City and Regional Agendas

Sustainable streets and mobility projects must demonstrate how local actions can support and enhance city and regional goals.

Cities and regions may have documents that set large-scale priorities and agendas, directing and guiding how they want to grow, develop, or change over time. These documents may be prescriptive, or play a role of guidance, identifying long-term goals.

Streets constitute the largest percentage of public space in the city, space which must be organized to best serve the city's population. Ensure local and regional governments integrate sustainable street design beyond their transportation policies and into their broader development goals.

Work with Multiple Constituents

Politicians
Politicians can be strong advocates for sustainable streets in their communities. Work with elected officials who play a strategic role in defining priorities and directing investment toward streets and transportation infrastructure.

Local Government Agencies
Coordinate with departments for transportation, urban planning, public health, development, construction, and sustainability to embed sustainable streets principles into their practices and decision making.

Regional and National Authorities
Engage with officials who set goals and priorities based on large-scale interests. They are able to keep the bigger picture in mind and see past political boundaries to set priorities at different scales; from regional and national transportation to environmental sustainability and social justice.

Private Practitioners and Researchers
Partner with private practitioners such as urban and transportation planners, urban designers, architects, and engineers, who can share their expertise and practical knowledge of innovative sustainable streets. Collaborate with academics and researchers to bring global best practices and processes to the table.

Advocacy Groups
Identify organized groups of citizens, nonprofit organizations, or associations focused on specific interests to provide important expertise and support for specific causes or users.

Local Communities
Engage citizens to learn about their expectations and concerns and gain crucial local knowledge about specific streets. Residents and informal groups should participate in the effort toward achieving sustainable streets.

Prioritize Areas in Need

City and regional agendas may identify the areas of most pressing need. These agendas can direct investment in sustainable streets and mobility options to areas where it can have the largest impact, and where particular strategies can help address specific challenges. These may be based on the following considerations:

Demographic Factors
Areas with high population densities, large numbers of residents or proportions of seniors, children, families, and people with disabilities.

Socioeconomic Factors
Communities with large proportions of disadvantaged populations such as those with low incomes, high unemployment rates, and low education levels.

Road Safety
Locations with the highest numbers of traffic fatalities and crashes.

Public Health
Areas with a high incidence of specific illnesses such as respiratory, cardiovascular, and other chronic diseases. Areas that are particularly polluted or close to heavy industrial sites.

Access and Mobility
Areas with poor transit access and gaps in pedestrian and cycle infrastructure. Areas with long commute times and high car-ownership rates, with lower demand for walking, cycling, or transit options.

Destinations
Areas with key destinations such as schools, hospitals, markets, open spaces, commercial corridors, and transit hubs.

Environmental Vulnerability
In some cases, investment is targeted toward areas that are particularly vulnerable to natural hazards and disasters such as coastal flooding, inundation, liquefaction, and mudslides.

2.3 | Involving the Right Stakeholders

Streets are shaped by many different stakeholders, varying as jurisdictional boundaries are crossed or as political leadership is changed. Find out who is involved in your local context, clarify responsibilities, and ensure that the street design prioritizes sustainable and active mobility choices that put people first.

Multiple levels of national, sub-national, regional, or local governments, technical professionals, the general public, and other constituents each have different interests. Understand and acknowledge each stakeholder's role—formal or informal—to facilitate a transparent process and help to reduce professional silos. Value diverse input to bring together local perspectives with technical expertise, and offer regular forums for intersectoral dialogue to support the long-term sustainability and retention of best-practice knowledge.

The following list gives a sense of some of the people, groups, and agencies whose various interests and efforts should be aligned to shape vibrant, engaging, safe, and functional streets.

Transportation departments and engineers develop long-term transportation visions and plans, regulate sidewalk, cycle, transit, and travel lane widths, manage traffic controls, regulate street furniture, and often maintain street surfaces. They are typically responsible for final approval of street designs and operations.

Transit authorities and operators control the collective transport facilities and infrastructure within the street.

Street operators manage parking, limit access, and maintain streets, formally or informally.

Parks departments often manage and maintain street trees and landscaping.

Environmental protection agencies often manage the stormwater that runs onto the street through curbside drains, and, at times, are also involved in the planning strategies and design reviews.

Construction and public works agencies manage the implementation of street and public works projects.

Sanitation and waste management agencies organize waste collection and recycling, conduct snow removal, and manage the overall cleanliness of the street.

Building departments often regulate what can project beyond a building or private property line into the public right-of-way.

Utility companies install and maintain utility infrastructure such as electricity or communication.

Consumer affairs organizations often regulate sidewalk cafés, commercial uses, and vendors by issuing licenses and enforcing compliance.

Departments and organizations supporting people with disabilities work to ensure safe and accessible streets for people with limited abilities.

Urban designers, landscape architects, and architects design integral elements of the street and its surrounding context, shaping how interesting and engaging the buildings, streetscape, and public spaces can be.

Planning departments are responsible for long-term land use and growth plans, policies that regulate building heights, setback dimensions, ground-floor uses, curb cut locations, entrances, levels of transparency, and outdoor uses.

Historic preservation organizations can identify and designate city landmarks and protect the character of streets.

Developers and development banks may fund projects that, depending on the scale, include new streets or the transformation of existing streets.

Health professionals can enact policies that encourage active mobility choices and increase physical activity levels.

Advocacy groups and neighborhood associations can be enlisted to support certain street designs or transformations.

Private property owners and tenants formally or informally maintain and manage the use of sidewalks, front yards, and entrance spaces.

Local businesses, vendors, and kiosk owners provide goods and services to street users, and may fund or manage ongoing maintenance through the creation of locally organized groups.

Local media can help promote and communicate the benefits of complete street design to the general public, shifting perceptions and influencing reactions to new projects.

Academic institutions such as planning, architecture, and public health schools, can partner with local governments and communities to assist with research, gathering metrics, visualizing development plans, and providing other resources to support street projects.

Enforcement entities can play a role in shaping user behavior, regulating compliance, providing surveillance, and reducing crime on streets.

2.4 | Setting a Project Vision

Driving extensive change in the process of street design globally requires setting a clear and strong vision for every street project worldwide.

A clear vision can provide a sense of direction for stakeholders and ensure that designs support the larger social, economic, and environmental goals of each neighborhood. A balance of technical expertise, global best practices, and input from local residents and business owners can increase support for the project and the sense of ownership in a shared vision.

Use the shared vision as a base to show what is possible and to test new ideas. Inspire participants to achieve collective goals, define actionable steps, and work strategically toward a coordinated outcome.

Having a shared vision can help maintain clear direction when projects and processes face challenges of increased complexity.

Cities adapt and change over time, so it is important to ensure a future vision that is flexible and robust in the face of growth, development, unforeseen decline, and climate change challenges.

Who Can Set Vision?

Local, Regional, and National Government Officials

- Demonstrate leadership by articulating and communicating clear, achievable, and shared goals.
- Allocate funding and resources to support implementation.
- Set precedents by achieving high-quality standards and showing what is possible.
- Work across departments to identify and realize synergies and mutual benefits from great street design.
- Enact supportive policies that simplify processes and change outdated practices.

Private Practitioners

- Visualize future visions in presented plans, projects, and competitions.
- Identify local codes, regulations, and policies that act as impediments to best-practice street design.
- Complete best-practice research and bring forward relevant precedents.
- Create best-practice streets through project implementation.

Community Advocates

- Ask for street designs that better function for all users.
- Demand a change of current street design practices to ones that support safe and equitable access for everyone.
- Communicate and advocate for identified priorities, and build community support around a future vision for your neighborhood.

Where to Start

Identify actionable steps and interim targets toward achieving a shared vision. Start with project elements that have clear community and political support, where the demonstrated need is the greatest, or the potential impact is the strongest.

Look, Listen, and Learn
Listen to what people have to say about an area; many of them use the streets every day and know them more intimately than other stakeholders. Use various transportation modes when doing field work to consider different user experiences. Identify how areas within the project site function differently. Identify best practices from other places and ask how they might be relevant if adapted to the local context.

Engage
Engage relevant agencies and local organizations to develop a shared project vision. Understand how they shape and use streets and what matters most to them. Host workshops and meetings, and engage many groups to participate in the process.

Challenge Existing Perspectives
Be bold in questioning existing perspectives, practices, and procedures that shape streets. These have led to the current existing conditions and a different future will require different processes.

Identify Shared Goals
Set the goals and targets together. Allow flexibility for streets to adapt and change over time while still allowing the goals to be relevant.

Set Actions and Timelines
Be specific about what you want to achieve. Provide clear short- and medium-term targets that allow the shared vision to be realized.

Partner
Foster and create new partnerships in which different groups can share resources, stay informed, and work together toward shared visions.

Determine Constraints
Balance the big-picture goals with an understanding of what is realistic given the existing constraints, practices, procedures, and budgets.

Identify Metrics
Identify metrics relevant to the project vision and use these to set goals and targets.

Communicate
Share the action plan for the project and the intended steps and timelines in place to achieve it. Develop a communication strategy to keep the public informed so that they can be a part of the process of achieving change.

Start Now
Find somewhere to start to demonstrate quick wins and achievable change in order to build momentum and trust. Consider pilot, temporary, or interim solutions as a first step.

Identify Priorities to Shape the Vision

Based on Need
- **Opportunities:** To help a city become more equitable, target investment in areas of need within the project, based on factors such as income, commute time, congestion, public health challenges, and lack of safe access to walking, cycling, or public transport.
- **Recommendation:** Map traffic crashes and fatalities geographically and identify areas where these cluster as targets or hotspots. Overlap income levels and transit maps geographically to identify where gaps exist for transit service. Work with communities, local health departments, and academic institutions to identify neighborhoods facing public health and environmental challenges.

Based on Destination
- **Opportunities:** Identify important destinations where people gather on a daily basis, such as schools, markets, open spaces, commercial corridors, and transit hubs as they can present valuable sites for street reconstruction and traffic calming.
- **Recommendation:** Map key city destinations in the project area. Identify potential locations for public transit stops, car share or bike share stations, and other facilities that support sustainable mobility around these destinations. Discuss and analyze the state of repair of sidewalks, cycle tracks, and transit stops in these areas, while noting the provision of street trees, seating, lighting, and other elements that support a safe and healthy street environment.

To Align with Other Projects
- **Opportunities:** When projects are funded and already in progress, they present opportunities to ensure that street designs align with larger vision goals.
- **Recommendation:** Identify projects and programs that already have political, community, and financial support, and streets that are already scheduled for regular or upcoming maintenance and reconstruction. Leverage these to support and enhance the project vision.

To Attract Other Investment
- **Opportunities:** Improved transportation infrastructure can proactively catalyze other investments. Strategically attracting public and private developments to certain areas of a city supports compact and sustainable development patterns and prioritizes them over areas where residents and workers rely on private vehicles.
- **Recommendation:** Identify the anticipated growth rate in the project area to inform the level of investment required to accommodate future street users in a sustainable development pattern. Align with land use and density goals to select limited geographic areas along existing or new transit lines that support growth in a compact form, protecting natural resources.

2.5 | Communication and Engagement

Successful street design projects rely heavily on effective communication and stakeholder engagement strategies to help constituents understand the project scope and impact.

When a project site and initial scope is identified, engage constituents through workshops, meetings, site visits, and presentations to find out what matters to them. Local constituents can offer critical insight to supplement the technical expertise of design professionals. Involving them in the process will help develop long-term stewards of the street, keeping it safe and well-maintained.

Identify effective communication and engagement strategies that are appropriate for each context and stakeholder group. Work together to clarify long-term goals, specific considerations, and top priorities. Maintain ongoing communications and engagement throughout the process of planning, design, and construction of a street, and continue to communicate successes or lessons learned as the project matures.

Effective Communication and Engagement Strategies

Spend Time On Site
Meaningful discussion about the future of a street requires experiencing its current conditions, and observing how different people use the space.

- Try walking, biking, using transit, driving, pushing a stroller, or even using a wheelchair on a site to better understand the perspectives of different users.
- Visit the site at different times of the day and night, week, and year, and document what works well and what does not.
- Study the flows, and identify places where people stay and spend time. Observe the activities people engage in and the relative speeds at which they move.
- Use photographs, drawings, and marked plans to document on-site conditions, and use this material to facilitate workshop discussions.
- Use bollards, chalk, paint, and planters to create temporary installations on site. Measure and observe the impact of these changes on movement patterns and behavior.

Understand Current Conditions
Discussing potential trade-offs between different uses in a limited space requires understanding spatial and functional constraints. Confirm dimensioned drawings during site visits or conduct on-site measurements to build accurate plans and sections, and use these as a base for redesign.

Offer Workshops, Meetings, and Presentations
Invite constituents to gather and discuss site conditions, identify opportunities, set visions, and clarify priorities. Offer multiple meeting times and choose locations near the site so local stakeholders of various demographics can easily attend. Use input and feedback from various constituents to inform designs.

Listen
Try to understand people's concerns. At times, misunderstanding project goals and impacts or the lack of meaningful engagement can result in a lack of community support for the vision.

Know the Audience
Adapt the message and presentation to suit the target audience. Avoid jargon or overly technical data that may lead to confusion. Offer stories, providing local examples and memorable anecdotes that can be easily remembered and repeated. Provide translation or use multiple languages when needed.

Think Long Term
Consider asking people how they want their city to look and feel in 20 years or for the next generation. Using a longer time frame can assist in reducing the level of fear many people have about changing the area they live or work in.

Find Local Champions
Identify key players in the local community and help them understand the benefits of an improved street. It is easier for the local champions to further communicate with the community about benefits of the street project.

Provide Precedents
Use examples of similar projects from other places to help people see already constructed improvements. In spite of diverse nature and geographic variations, many of the challenges cities face are similar and strategies can be easily adapted from one place to another.

Present Evidence
Identify relevant scientific evidence to help people understand the multiple benefits of a street improvement. For example, show that the designs can reduce urban heat island effect by planting trees, that more sustainable and active mobility choices can mean healthier citizens, or that fewer on-street parking spots can mean more space for other uses.
See 3: Measuring and Evaluating Streets.

Manage Media
Identify the most appropriate media to engage various stakeholders. Certain populations engage more with digital online media, some with radio and printed news, and others with visual drawings and videos. Online and in-person surveys can be an efficient way to gather important information, and participatory mapping can give the community a chance to feel that they are active contributors.

Engage the Press
Proactively engage local press to keep them informed. Ensuring that they have accurate information about a street project can assist in building awareness and communicating success. When proposed street transformations or new construction do not balance the needs of different users, engage the media to raise awareness and build support for alternative designs that put people first.

Engage the Youth
It is important to expand the community involvement to include youth. Young people bring innovative ideas and need-based solutions. They can be involved in the decision-making process and can be motivated to help activate and maintain their neighborhood streets.

2.6 | Costs and Budgets

The Commission for Global Road Safety recommends that 10% of total project costs be allocated to safety, inclusive of Non-motorized Transportation (NMT) infrastructure.[1]

The costs of building great streets are vastly different in different countries and depend upon a number of variables. The scale of a street is a primary determinant of overall costs, as wide streets that run for longer distances cost more than narrow profiles. It is also critical for long-term planning to consider the overall balance of up-front capital costs with lifecycle costs, including operation, maintenance, repair, and replacement. Investing in quality design and materials early in a project will save costs over its lifecycle.

Consider local budget timelines, multiple sources of funding, and aligning projects with new sustainable streets initiatives where possible.

Cost Variables

Ensure the following variables are considered at the outset of each streets project:

Materials
Material costs will vary based on local availability, location, and transportation. Modular units installed on site can be more cost effective.

Labor
Labor affordability and availability differ greatly across various countries and regions.

Technology
Signals and enforcement cameras are prohibitively expensive in some places, and ongoing repair or maintenance costs can see them installed but not used. Reliable sources of energy are not available in all places, and so renewable energy back-up systems are needed, and these may add to the cost.

Duration
Design and construction duration can impact the overall cost, influencing labor costs, equipment rental, or lost income for adjacent businesses. Large capital projects are also affected by inflation rates.

Climate
Certain climates require specific construction materials that can endure extreme heat or cold, impacting overall costs. Places with extreme climates may also need to account for additional maintenance costs in their recurring budgets.

Maintenance
Build maintenance into the City budget and establish partnerships with local organizations, business groups, and adjacent property owners to participate in maintenance efforts. Build local pride and stewardship in the community.

Topography and Geology
Natural site conditions can impact construction processes and required materials. Particularly soft soils might be prone to erosion or require additional construction steps, while harder bedrocks might impact construction duration.

Hidden Costs
Site complexity and incomplete site analysis can result in unanticipated costs, such as finding an unexpected utility line or moving a drain which was not accurately noted in original drawings. Ensure contingency costs are included in total budgets to cover such circumstances.

Types or Scales of Projects To Be Funded

Sustainable streets can be identified and achieved at multiple scales. Consider the following project types for funding opportunities:

Large-Scale Projects
- Major area or neighborhood redevelopment
- Full corridor reconstruction
- Introduction of a light rail or BRT corridor
- Single block reconstruction

Smaller-Scale Projects
- New sidewalks for a corridor
- Protected bike lane
- Parklet
- Neighborhood street tree program
- Street activity program and temporary closure

Funding Sources

Available funding sources vary by context, and may include the following:

Government Budgets and Funding
- **Local Governments**
  Capital budgets
  Operational budgets
  Participatory budgeting
- **Regional and National Governments**
  Grants and capital funding
- **Supranational and International**
  Economic communities
  Development banks
  Unions grants

Private Sector Partners
- **Project Financing.** Plan for long-term financing of infrastructure and industrial projects based upon the projected cash flow required for the project rather than the capacity of its sponsors.
- **Institutions and Organizations.** Consider working with local hospitals, academic institutions, or other philanthropic organizations that could benefit from the nearby transformation.
- **Developers.** Large projects should incorporate best-practice street design strategies from the outset. Local authorities can provide construction incentives to developers in return for street improvement and maintenance responsibilities.

International Development Banks
Sustainable streets and multimodal mobility should be considered in any grant or loan proposal for international development bank funding.

Project-Generated Cashflows
Funds sourced as a direct result of transit operations.

Crowd Sourcing and Donations
More conducive to temporary or small-scale, community-led street transformation projects, crowd funding and crowd sourcing solicit small contributions from a large number of individuals to achieve a bigger impact. Financial donations or the provision of labor or services are usually conducted using an online platform. This form of fundraising can complement larger donations or grants.

Social Impact Bonds (SIBs)
SIBs allow investors to cover upfront project costs. Investing in infrastructure that supports physical and social health can reduce long-term public expenditure. The public sector pays the return to the investor based on the delivery of successful results.

2.7 | Phasing and Interim Strategies

Interim design strategies offer an opportunity to quickly demonstrate change, allowing communities to experience an alternative condition and see progress in a short time frame.

Changing decades of embedded practice in designing urban streets can be challenging. A lack of proven local precedents, limited funding, and regulatory restrictions can lead to hesitation in the face of innovative solutions. Lengthy construction periods and frustrating wait times for nearby residents and businesses further add to reluctance toward implementation.

Interim materials or phased solutions provide opportunities to quickly demonstrate change, at a lower cost, and are therefore more easily approved. Before and after comparisons reveal solutions that work and ones that don't. Interim phasing should be used to inform long-term solutions.

Some cities brand the interim design as a pilot or test phase for a project, and others view the design as equivalent to permanent reconstruction. While a majority of these pilot projects go on to become permanent capital projects, some are altered or redesigned in the process based on their performance. This results in a better final product and saves the expenditure of future improvements or revisions.

Interim Elements and Material

During the life cycle of a street, the original design and roadway geometry may no longer meet the needs of the community. To address the need for roadway retrofits and urban traffic calming, use inexpensive, easily deployable, and non-permanent solutions that work on an area-wide scale.[2]

Modular Curbs
Small concrete dividers or parking bumpers can be installed for overnight transformation of streets to reflect the desired configurations, without expensive and permanent infrastructure.

Flexible Bollards
Plastic delineators are easy to install and remove. They can help in directing traffic flows and offer resistance to vehicular speeding without posing a risk. These also augment other vertical devices such as stone bollards and jersey barriers.

Paint and Thermoplastic
Surface materials can be applied quickly and relatively inexpensively. They do not create a physical barrier and may be combined with other elements for that purpose. These generally act as visual devices that force drivers to slow down, carefully read the roadbed for movement, and yield to pedestrians.

Planters
Planters can be used to create inexpensive yet aesthetically pleasing installations that define medians, islands, curb extensions, plazas, footpaths, and cycle tracks. Planters also add vegetation and greenery to the street.

Temporary Site Interventions
Temporary interventions can be implemented and tried on site for varying durations, from a few hours, a day, or even a week. They help street users visualize alternate uses of the street space and can be effective tools for public engagement.

Moving the Curb

Many streets have a curb to indicate a separation of space between pedestrians and other modes of transport. Rethinking the curb and moving it to better balance all the users of the street can transform how the street functions, looks, and feels. Interim strategies allow streets to adapt quickly to changing contexts. Use the following strategies to transform streets and intersections to make them safer and more convenient for sustainable mobility choices.

Parklets
Parklets are public seating platforms that replace several parking spaces. They serve as a gathering place for the community and can revitalize local businesses. *See 10.3: Pedestrian-Priority Spaces.*

Sidewalk Widening
Sidewalks can be expanded using interim materials, such as epoxied gravel, paint, planter beds, and bollards, easing pedestrian congestion in advance of a full reconstruction.

Intersection Redesign
Interim markings with bollards or planters can change the geometry of an intersection and help revitalize a neighborhood, while increasing accessibility and making mobility more intuitive.

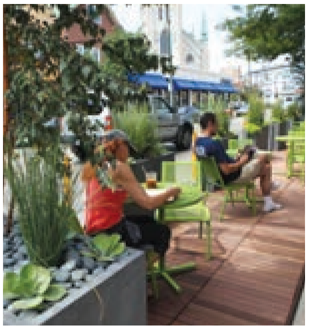
Traffic Calming
Temporary traffic calming devices may be installed using pedestrian curb extensions at mid-block crossings or at street corners, or by using landscaping and narrow drainage channels. These may be designed as quick, inexpensive elements using paint and plastic bollards, or with use of permanent elements such as raised islands.

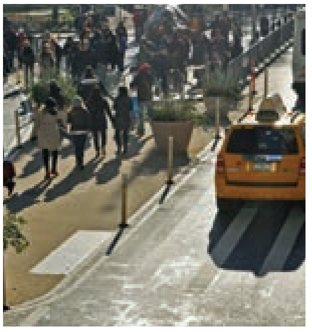
Cycle Corrals
Cycle corrals typically replace one parking space at the request of a local business or property owner and accommodate 12–24 cycles. Corrals can be installed at corners to increase visibility.[3]

Vendors and Food Trucks
Vendors and food trucks can provide valuable services where they are lacking. Areas close to key destinations such as transit stations may dedicate parking spaces for these uses so that clear walking paths may be safely maintained.


Movable chairs and table reclaim pedestrian space in a parking lot.


Flexible bollards delineate an interim bike lane.


Parklet installed to provide additional pedestrian space.


Planters and paint used to create an interim plaza.

2.8 | Coordination and Project Management

Effective project management involves planning, coordinating, and managing resources to ensure that a project successfully achieves its target goals within the given constraints.

Great street designs cannot be realized without effective coordination and project management. Identify all relevant project stakeholders and define project roles early. Maintain clear communication and coordination from start to finish, and ensure appropriate agencies and technical experts provide consistent input at all stages of project design and development.

Coordinate among the various stakeholders, designers, and project executors to clarify the project scope, schedule, budget, and desired outcomes.

Pre-Project Planning and Coordination

Ensure that adequate planning and coordination takes place before a project begins, so everyone is working toward the same identified objectives.

- Identify clear schedule, budget, scope, and quality objectives for the project.
- Clarify any constraints on the existing site.
- Engage all parties from the very beginning, showcase the benefits of the project, and set up an ongoing transparent system of communication.
- Establish clear roles and responsibilities of all stakeholders.
- Coordinate project plans to align with local policies, guidelines, and codes.
- Identify potential impediments early in the process and allow for unexpected costs and delays.
- Establish a timeline for routine follow-ups, site visits, and updates to ensure that the project is implemented as planned and that challenges are addressed as soon as they occur.
- Coordinate with adjacent ongoing work in order to achieve greater impacts and reduce future reconstruction or repair.

Interagency Coordination

Coordinating the many agencies that are involved in shaping streets can be challenging, but it is critical to the success of a project.

- Coordinate projects, schedules, and budgets with planning, transportation, health, design and construction, parks, enforcement, utilities, and other departments as necessary.
- Define a coordinating entity dedicated to organizing taskforce teams.
- Hold regular meetings and facilitate interagency communication.
- Coordinate with regional and national governments and seek better integration into the process of large-scale plans.

Public-Private Coordination

Project managers should facilitate coordination between all public agencies involved in the project as well as between the public and private sector parties.

- Ensure that the client is regularly informed about the development and progress of the project.
- Inform all contractors of the objectives and schedules.
- Engage local constituents who are interested in the project.

Coordination with Utility Companies

- Coordinate with utility companies and maintenance stakeholders to help them understand how their work supports the long-term success of the project.
- Clearly communicate project goals and ensure guidelines are created for returning the street to its existing or improved condition.

Communicate Information

- Provide clear design documents, visual guidance, and diagrams with easy-to-follow instructions to ensure quality construction.
- Keep community members informed throughout the process to build and maintain support.
- Communicate progress using multiple mediums, such as online, update signs, weekly flyers, or in-person meetings and announcements.
- Consider hiring a dedicated staff person to keep people informed on a regular basis.

2.9 | Implementation and Materials

Quality materials and construction practices that account for the local context will increase the lifespan and usability of the street.

Construction Quality

Well-constructed streets with strong foundations are more durable and can adapt and react to geologic, hydrologic, and seismic effects. When devising construction techniques and schedules be sure to account for ground water, soil compaction, land subsidence, earthquakes, and other subsurface conditions, as well as extreme temperatures, extreme rainfall, snowfall, wind, and humidity. Regardless of the quality of materials chosen, poor installation will compromise their lifespan and usability. It is important to note material requirements such as sufficient curing time for concrete, proper compaction for sand and gravel, proper mixing of mortar, and secure sealing of pipe joints, especially in underground conditions.

Material Durability

Select materials for durability and minimal maintenance requirements. Balance the cost of a better material with that of maintenance. If labor costs are high, it is often better to spend more on the material. Consider the costs of long-term maintenance when selecting materials.[4]

Material Availability and Sustainability

As a public good, the construction of streets can set a benchmark for sustainable materials and lifecycle costs.[5] Source materials locally to minimize shipping and replacement costs, and to lower environmental impacts. Reuse materials such as crushed concrete from demolished buildings or roads instead of sending them to landfills. Consider locally sourced aggregate and recycled materials as alternatives to cement in order to reduce emissions during the construction and maintenance.[6]

Utilize landscaping and permeable paving as much as possible, especially in parking spaces, wider sidewalks, utility strips, medians, and curb extensions. Permeable paving can infiltrate as much as 70%–80% of annual rainfall and can have a lifespan of 20–30 years before requiring significant maintenance. Employ and adopt local knowledge of materials, construction techniques, labor availability, climate, and street use. Using local materials may require some experimentation to adjust for quality and environmental variations, but this testing builds and expands upon knowledge of local materials and supports local economic resources.[7]

Maintainability

Maintain streets regularly to increase the usable lifespan of a road while decreasing service interruptions, resurfacing costs, and environmental impacts.[8] Proactively maintaining a road is cheaper than letting chronic issues develop to the point of road failure. Ensure continual maintenance of a street and its furnishings by formal or informal agreements with public or private partners. Facilitate access for regular maintenance and upgrades by locating and consolidating utilities in a section of the street that would be accessible with minimal disruption to users.

Impacts of Construction Process

Street construction projects disrupt the community with noise, smells, vibration, dust, and blocked sidewalks. Construction can force detours for travelers and deliveries. To minimize impacts during implementation:

- Schedule construction on weekdays or weekends, depending upon the context, to minimize disruption to users. Avoid nights and holidays.
- Maintain access to properties at all times.
- Secure adjacent structures and make repairs quickly.
- Protect trees and natural features.
- Maintain traffic flow as much as possible. However, closing a street might accelerate the overall construction process.
- Keep neighbors informed of the construction schedule and provide overall project updates. Use websites, social media, flyers, and hotlines. For larger projects, consider establishing a project information kiosk.

Build for Most Vulnerable Users First

Prioritize vulnerable users before motorists. People walking and cycling benefit more from paved and accessible streets, as motorized vehicles are better able to traverse poor terrain.

2.10 | Management

Planning and coordinating on-street activities is important to ensure that the needs of all users are met.

Public agencies and private institutions must collaborate to facilitate optimal use of streets and related infrastructure. Whether handling maintenance needs, weekly activities, or special events, managing activities and operation helps to keep things in order.

Coordinating essential services such as street cleaning, freight access, programming, and curbside management requires complementary education and enforcement.

Integrate management plans and strategies into the design process; include flexibility for different street functions throughout the day, week, and year.

Coordination of Use

Certain streets will require movement and hours-of-operation restrictions to be implemented to manage the best possible street usage. This guidance may include hours of operation, loading restrictions, or restricted entry for private vehicles on certain days.

Public-Space Programming

Community partners, local agencies, and private organizations can be responsible for programming public spaces. Planning and organizing daily and long-term activities can help to attract various users to the space during different times and seasons.

Extreme Weather Conditions

Streets should be managed and maintained to incorporate and anticipate risks related to extreme weather conditions. Ensure accessibility to all users under these circumstances. When clearing snow or ensuring adequate drainage, prioritize areas, such as sidewalks, where the most vulnerable users need continuous access. Snow removal, for example, can be very expensive. In some cases, the investment in new design that will eliminate or minimize the need for snow removal is almost equivalent to the removal costs.

Safety Management and Enforcement

Ensure safety for all users through effective signal controls, road signs, and enforcement. Work closely with local enforcement to help them understand how they can contribute to creating safer streets. Educate the community on the importance of safety and enforcement measures.

2.11 | Maintenance

Ongoing street maintenance can greatly increase the usable lifespan of infrastructure. Proactively maintain a street to avoid chronic issues developing to the point of major disrepair.

Maintain a street with regular street cleaning and sweeping, permanent and semi-permanent repair of cracked surfaces and potholes in sidewalks and roadbeds, resurfacing, replacement of damaged street elements, and repair of utilities.

Ensure ongoing maintenance costs are accurately reflected in the initial project costs. Learn from past experiences and communicate with agencies from other cities to inform material choices and good maintenance practices.

Many places will find proper maintenance difficult due to lack of funds, equipment, or skilled labor, in addition to climate-related challenges. It is critical to identify which mix of resources can be used most effectively for the local context.

Good design makes maintenance easier. Consider the following strategies when planning for street maintenance.

Prevention

Prevention is a fundamental aspect of street maintenance and management, and includes surveys, inspections, preventive maintenance, and utility management. Regular inspections and assessments can help in timely identification of elements in need of maintenance. Utility management refers to the maintenance of underground utilities in order to avoid damage to the street. Resurfacing and reconstruction decisions need to be taken into consideration to minimize recurring costs through extra maintenance. Understand the lifecycle of materials and elements and schedule timely maintenance and replacements accordingly.

Street Cleaning

Frequent cleaning keeps streets and public spaces in a safe and clean condition. This process places regular eyes on the street and helps to identify problems early on.

Local Stewardship

Engage local constituents. People take pride in their environment and providing an easily maintained street helps them take care of it. Local stewardship and ownership by means of daily maintenance like cleaning, watering trees, and unblocking gutters can go a long way in supporting more formal maintenance procedures.

Involvement of Stakeholders

Educate responsible parties such as local agencies, private stakeholders, and adjacent communities on the benefits of maintenance and their roles in shaping the streets.

Maintenance Over Time

Complete short- and long-term lifecycle cost analysis to help build ongoing maintenance into other budgets. Street conditions and usage may change over time; designing streets to adapt to different uses is critical to long-term sustainability. This may also involve replacing or making temporary installations more permanent.

2.12 | Institutionalizing Change

Policies reflecting desirable future conditions—and not documenting past trends—should drive decisions about street design.

Policies and Strategies

Individual street transformations can demonstrate results and build momentum toward broader change. Each project must work toward embedding this new approach to street design into local codes, training curricula, and political campaigns.

Policies reflecting desirable future conditions—and not documenting past trends—should drive decisions about street design. When the evaluation of a pilot or completed project demonstrates positive outcomes in various categories, it should be utilized to update policies, remove impediments to best practices, inform new local design guidelines, and alter existing transportation or engineering models. The following tools and policies can be updated to incentivize and require sustainable street design practices.

Local, Regional, and National Policies
Ensure the study, evaluation, and applicability of local, regional, and national policies. Use street redesign projects to inform policies at all these scales based on the authorities and different jurisdictions responsible for the street right-of-way. Remove impediments from all sources in order to promote successful design measures through institutional support.

Mobility Plans
Ensure all mobility plans include design guidance, minimum standards, and performance metrics to promote walking, cycling, and transit use.

Transportation Investment Policies and Strategies
Shape or adjust mandates to require a percentage of every street project budget be put toward active and sustainable transportation.

Street Design Guidelines
Develop local guidance on minimum quality standards and dimensions for best-practice streets.

Zoning codes
Allow, incentivize, and require the implementation of best practices. Align areas of growth with transit corridors; reduce or eliminate minimum parking standards; and update pedestrian ramps regulations. Provide requirements and incentives for ground floor uses and transparency levels to activate the street environment.

Master Plans
Provide guidance and requirements for street design for new neighborhoods and other large-scale developments.

Sustainability Plans
Ensure street design and sustainable mobility are part of sustainability plans.

Education

Ongoing education, training, and site visits for professionals working in the transportation, planning, and engineering fields are important to ensure that best practices, new language, innovative approaches, and lessons learned find their way into the everyday practice of shaping streets in each place.

Academic Training
Coordinate with local academic institutions to ensure that the professionals of tomorrow are equipped to grapple with the complex needs of urban streets. Structure educational curricula to look at global best practices while studying the local contexts.

Ongoing Professional Development
Work with local professionals and organizations to extend the resources available for ongoing professional training through educational trips, workshops, and sessions. These collaborations can help inform professionals and educate them on strategies that should be advocated for at public council meetings, civil society sessions, and community meetings.

Public Education Campaigns
Support public education on the design and use of great streets through campaigns, community engagement, and enforcement. It is important that the local community knows what to expect from street redesigns and operational changes, why it is important, and how the outcomes will benefit them. Community support is critical to the success of any project. When new transportation systems or services are introduced, or new street designs are implemented, provide street users with information about expected changes and safety measures.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3

Measuring and Evaluating Streets

Cities must set new goals for their streets to meet the many demands placed upon them. Measuring the success of each street project requires a multidisciplinary and multiscalar approach and methodology so that the many benefits of street projects may be captured. For decades, streets have been evaluated based on the movement of vehicles and the safety of drivers, but the true mobility function of a street can only be measured when the safety and movement of all users are considered.

Beyond mobility, cities must evaluate completed street projects to understand whether investments support the larger goals and policies of public health and safety, quality of life, environmental and economic sustainability, and equity. Measuring the physical and operational changes of a street project and documenting the shifts in use and function of the space allows the larger impacts of a project to be tracked over time. The evaluation of completed projects informs the design of future streets and is therefore vital to building public and political support for change.

London, United Kingdom

3.1 | How to Measure Streets

Copenhagen, Denmark: Cycle counters on Nørrebrogade bridge track the number of riders per day and year in a city where 45% of all journeys to places of work or education are made by cycle.

If you can't measure it, you can't manage it.

—Michael Bloomberg

What to Measure

Measurements can focus on physical and operational changes, shifts in use, as well as their resulting impacts. The tables in *Appendix B* list potential measurements to evaluate the impact of street projects of various scales. Measure as much as possible, but be strategic in prioritizing time and resources to collect the metrics that most relate to the project goals and community interests.

Once relevant metrics are identified, measure the same categories for the project before and after implementation.

Use the variation between the two sets of data to examine the changes to the street condition, to measure shifts in use and function, and to evaluate the resulting impacts.

Benchmark variations and net changes against prior conditions, other project sites, control areas, citywide data, or other cities, nationally and internationally.

There are three main categories of metrics discussed in this chapter:

- **Physical and operational changes:** Document new or improved facilities, technologies, and infrastructure to build a database of sustainable streets infrastructure and to track short-term results. Collect quantitative information such as increased length of cycle tracks or transit-only lanes, area of improved sidewalk, or the number of new trees planted. Communicate this information when reporting back to communities, politicians, decision makers, and advocates about progress toward meeting infrastructural targets.
- **Shifts in use and function:** Measure how a street is used differently as a result of the project. Changes in behavior, new users, enhanced transit flow, and improved functions, such as water management or energy generation, assist in demonstrating how streets can serve a wider percentage of the population and offer multiple benefits to communities.
- **Resulting Impacts:** Measure how the physical, operational, and functional changes impact the overall performance of the street.[1] This longer-term evaluation of a project is an important part of understanding whether an investment or implementation is having the desired outcomes as set forth by the larger goals of public health and safety, quality of life, environmental sustainability, economic sustainability, and equity.

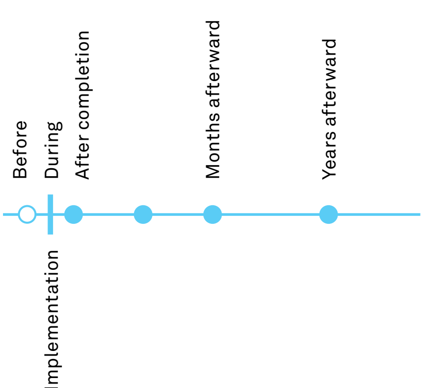
Every metric will not be applicable to all street projects or all contexts. Each community must determine its own priorities and adopt measurements that are relevant and appropriate to the project scale, whether it is an intersection, a street, a corridor, or a neighborhood network project. Some metrics listed are based on commonly available quantitative and qualitative information, while others will need to be collected through agreed-upon methodologies and site surveys.

Identify Existing Data

Work with local stakeholders to identify the types of data already available and collate this data to provide a basis for potential evaluation. Identify opportunities to add questions to existing surveys that are already being conducted, or include new metrics in other stakeholder collection methods.

Consider the following examples as opportunities to investigate local data sources that might relate to streets projects:

- Local, regional, and national census data or similar surveys might include traffic volumes, major street conditions, and mode share information. They can also include surveys of businesses, residents, retailers, and tourists.
- Police and hospitals track traffic-related fatalities and serious injuries.
- Public health agencies often conduct community health surveys, tracking chronic and respiratory disease rates and daily physical activity levels.
- Insurance agencies track crash rates and hospital admissions.
- Environmental groups and agencies measure water and air quality.
- Advocacy associations, organizations, and academic institutions often maintain a range of data sources.
- Realtors collect information on property values.
- Local governments often have information on tax revenues, property values, and crash statistics.
- Business groups may maintain data on pedestrian volumes and sales.
- Phone call-in systems sometimes collect self-reported street-related issues from citizens.



Timeline for collecting relevant data.

Develop a Performance Metrics System

Measuring the performance of a street is a complex exercise as each street is different and must serve many needs and functions.[2]

- Develop a performance measurement system that reflects local priorities and allows for flexibility over time.
- Identify the metrics that will be most easily measured.
- Develop data collection protocols and inventory sheets, determine consistent times and frequencies, and establish ratings that reflect priorities.
- Train local staff and professionals to embed these in local processes and build capacity.
- Maintain consistency, communicate results, and refine the process over time.

Collecting Data

When relevant data does not exist, identify appropriate methodologies for measuring the condition, function, use, and impact of streets. Identify processes that are efficient and cost-effective.

Quantitative and qualitative metrics are necessary and equally important to measure the various impacts of a project. Counts are helpful for metrics such as user volumes and speeds, but a great deal can be learned from talking to people using the street and conducting surveys of local residents, business owners, and visitors.

Methodologies can include:

- Before-and-after photographs.
- Imaging data such as aerial photos, time-lapse photos, and videos.
- On-site user perceptions, surveys, or manual counters. Test draft surveys and prioritize questions to match the expected time for responses, whether quick 5-minute interviews or longer 15-minute household surveys. Note locations where surveys were conducted.
- Automated data collection through devices such as Automated Traffic Recorders.
- Crowd-sourced data such as call-in logs and mobile phone GPS data.

When to Measure

Collect data before and after a project to provide comparisons and capture impacts.

Collect measurements during different seasons, at various hours of the day, and during weekends and weekdays to be able to comprehensively compare how the use and function of the street changes after project implementation.

When measuring longer-term changes in function, use, and performance, measurements should be collected after multiple months and years for reliable comparison.

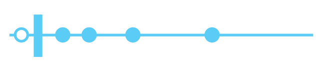
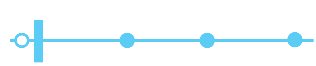
For the most accurate comparisons, be consistent with locations when collecting measurements, as well as times and durations when measuring use and function.

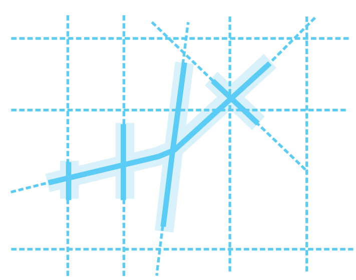
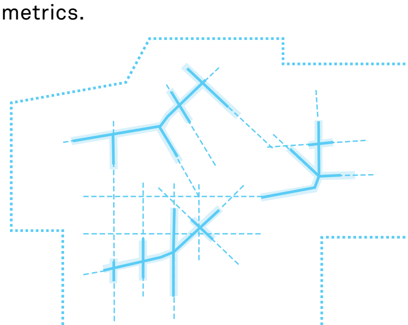
Before

After

Before-and-after photographs are helpful in reminding people what is possible. Be sure to match views carefully and crop to concentrate on the area of interest.

3.2 | Summary Chart

	What to Measure	When to Measure	Why It's Important
Measuring Physical and Operational Changes	The physical and operational changes resulting from a specific project.	Before: Measure and document existing site conditions. After: Measure immediately after construction completion.  Implementation	• For benchmarking against prior conditions or control areas. • To build an inventory and database of the city's infrastructure. • To demonstrate and communicate short-term achievements and progress to stakeholders. • To measure perceived quality of conditions.
Measuring Shifts in Use and Function	The change in behavior and use of the street. Identify how and why the street functions differently, and measure the level of satisfaction with the changes.	Before: Observe and document existing use and function. Note locations on site plans. After: Measure periodically after 1, 3, 6, and 12 months. Measure during different seasons and at varying times of the day and week.  Implementation	• To evaluate success of intended change in behavior and function. • To measure user satisfaction and user perception. • For benchmarking against prior conditions and other projects. • To build an evidence base for sustainable streets • To learn lessons and inform future street designs.
Measuring Resulting Impacts	The extent to which the project contributes to larger local and regional goals and principles of: • Public Health and Safety • Quality of Life • Environmental Sustainability • Economic Sustainability • Equity	Before: Identify existing metrics or collect new data relevant to project goals and priorities. After: Measure matching metrics periodically after multiple months, and after 1, 2, and 3 years.  Implementation	• To evaluate long-term impacts and benefits. • To benchmark against larger citywide goals and priorities. • To build an evidence base for sustainable streets. • To measure return on investment and evaluate cost effectiveness. • To communicate and build support for sustainable streets.

How to Measure	Where to Measure	Example Metrics
Before-and-after photos and videos	Project site and immediate surroundings. Maintain consistency with locations measured. 	• Length and width of new and improved sidewalk. • Added length of cycle tracks. • Added length of dedicated transit lanes. • Improved signal timing for pedestrian crossing length. • Number of additional trees planted. • Percentage of residents happy with specific facilities or conditions.
Before-and-after plans and sections		
Qualitative surveys of infrastructure quality		
Before-and-after photos and videos	Project site, connecting networks, and surrounding neighborhood. Maintain consistency with locations measured. 	• Shift in mode share and user counts. • New or changed non-mobility activities. • Change in average vehicular speeds. • User preferences. • Volume of water treated or infiltrated.
On-site counts and observations Note locations		
Quantitative analysis		
Qualitative surveys		
Quantitative analysis	Project, neighborhood, network, and citywide scale. Choose scales relevant to specific metrics. 	• Road safety (KSI/ fatalities and injuries by location). • Respiratory and chronic disease rates. • Air quality. • Total CO_2 from transportation. • Water volumes diverted from city system. • Property values. • Percentage of population with access to public transportation. • Perceived quality of life.
Qualitative surveys		
Comparative analysis of census results		
Environmental analysis		

3.3 | Measuring the Street

When collecting metrics at the level of the street and evaluating the changes and impacts, it is important to select relevant metrics from all three categories—physical and operational changes, use and functional changes, and resulting impacts—to ensure comprehensive before-and-after comparisons. The graphic below spatially demonstrates some of the key categories and corresponding quantitative and qualitative metrics that should be collected for a project. This sample list should be used in conjunction with the complete set of metrics in *Appendix B*. Metrics can be used to compare a street to another context or for benchmarking against prior conditions.

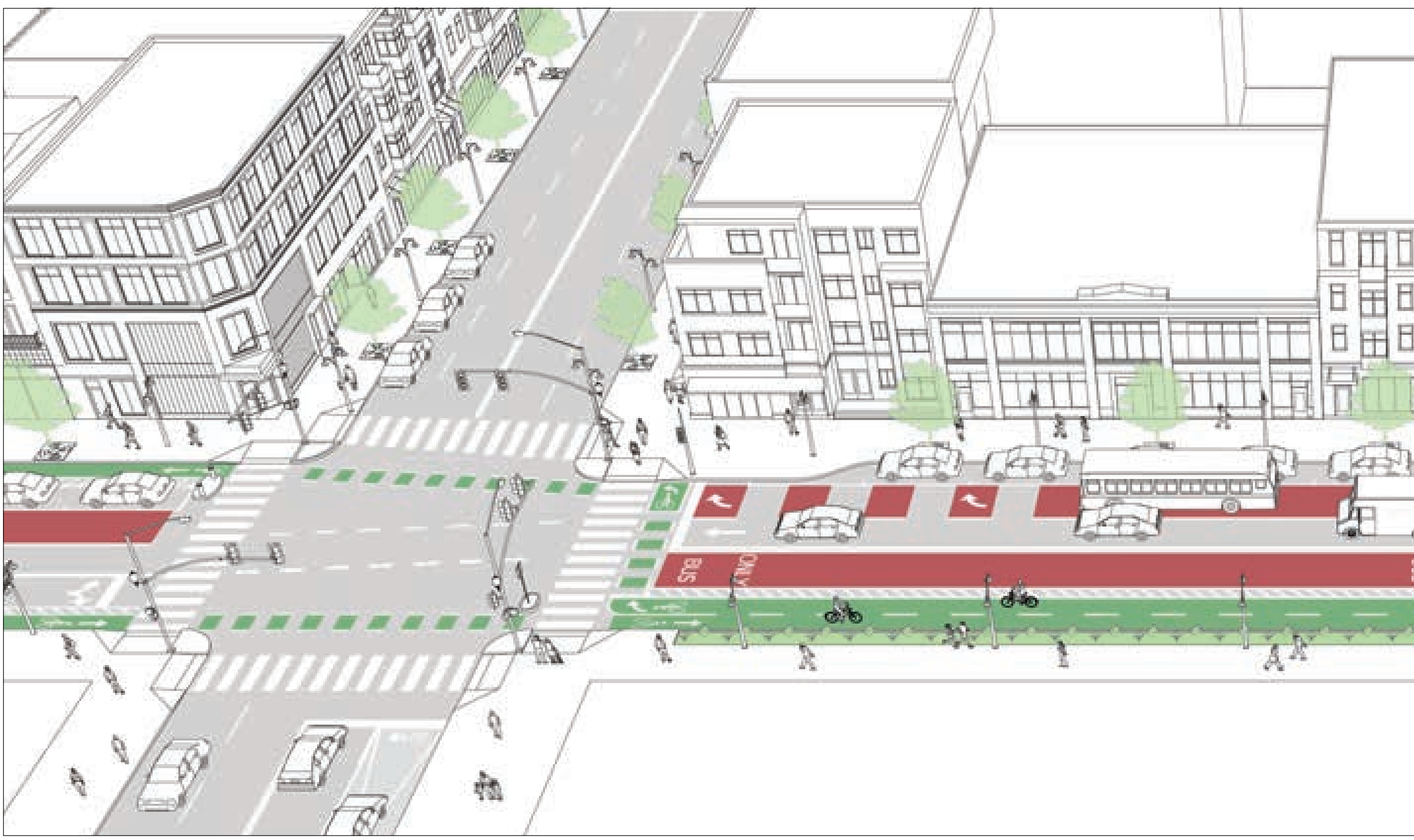
Physical and Operational Changes

Pedestrian Facilities

- Width of sidewalk and clear paths
- Spacing, width, and length of pedestrian crossings
- Accessibility ramps
- Other sidewalk furniture and facilities

Cycle Facilities

- Length and width of cycle facilities by type
- Percentage of total segments with safe and comfortable facilities
- Number of cycle share stations and locations



Use and Functional Changes

User Counts

- Number of people walking, cycling, crossing, using transit, driving
- Number of commercial vehicles, freight trips
- Number of pedestrians by type of activity and duration of stay

Behavior and Comfort

- Percentage of users that feel safe and comfortable by mode share and facility type
- Number of cars speeding
- Perception of cleanliness

Commercial Activity

- Number of storefronts per block or 100m, by type and land use
- Number of jobs within the area
- Percentage of vacant retail fronts
- Number of vendors
- Retail rents and land value

Environmental Quality

- Amount of electricity consumed
- Percentage of waste collected for recycling
- Volume of treated stormwater
- Percentage of street with shade

Transit Facilities

- Length and width of dedicated/shared transit facilities
- Location, quality, and frequency of transit stops/shelters
- Number of accessible stations

Freight and City Services

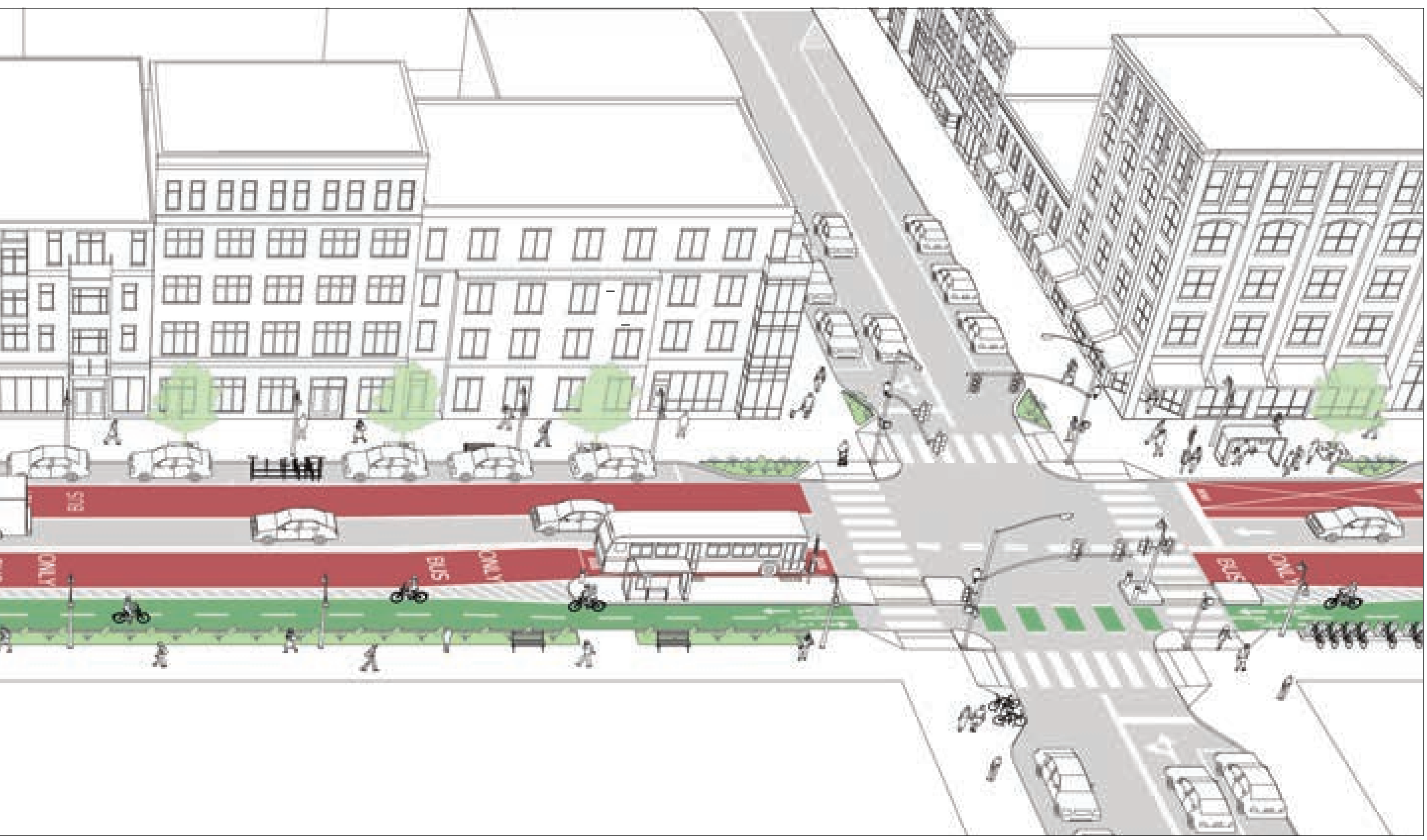
- Number of loading bays
- Number of waste and recycling facilities
- Width of emergency vehicles access
- Number of parking bays reserved for other services

Operational Conditions

- Signal cycle durations
- Number of phases and frequency of intervals
- Loading and parking hours and regulations
- Direction of travel

Street Conditions

- Block sizes and width of street cross section
- Number of and location of trees and other green infrastructure
- Number and frequency of intersections



Resulting Impacts

Safety

- Number of crashes per year
- Breakdown of crashes by mode, user, type, location, and time of day
- Crime rates by type, location, and time of day

Human Health

- Percentage of people walking or cycling on a daily basis
- Percentage of population with depression
- Percentage of population with respiratory diseases

Environment

- Levels of particulate matter
- Levels of noise from trucks and automobile traffic
- Drainage rates after heavy rains
- Average temperatures
- Number of plant species

Quality of Life

- Number of people living close to cycling or transit facilities
- Total travel times by mode and user
- Number of jobs and access to them
- Level of satisfaction with local street conditions

B

Street Design Guidance

4

Designing Streets for Great Cities

Streets lie at the heart of communities, shape human health and environmental quality, and serve as the foundation of urban economies. In many cities, streets make up more than 80% of all public space, and collectively have the potential to foster business activity, serve as front yards for residents, and provide safe places for people to move and spend time. The vitality of urban life demands a design approach sensitive to the multifaceted role streets play in our cities. Shaping great streets is fundamental to shaping great cities.

Amsterdam, The Netherlands

4.1 | Key Design Principles

The *Global Street Design Guide* crystallizes a new approach to street design that meets the challenges of today and the demands of tomorrow. Based on the principle that streets are public spaces as well as arteries for movement, the guide foregrounds the role of the street as a catalyst for urban transformation.

It reinforces the tactics and techniques being pioneered by the world's foremost urban engineers and designers.

In an urban context, street design must meet the needs of people walking, cycling, taking transit, doing business, providing city services, and driving, all in a constrained space.

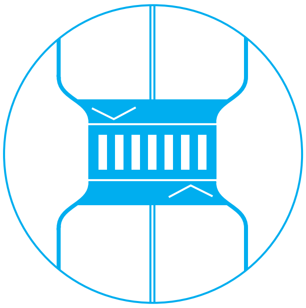
The following principles are key to shaping great streets.

Streets for Everyone

Design streets to be equitable and inclusive, serving the needs and functions of diverse users with particular attention to people with disabilities, seniors, and children. Regardless of income, gender, culture, or language, whether one is moving or stationary, streets must always put people first. *See 6: Designing Streets for People.*

Streets for Safety

Design streets to be safe and comfortable for all users. Prioritize the safety of pedestrians, cyclists, and the most vulnerable users among them: children, seniors, and people with disabilities. Safe streets have lower speeds to reduce conflicts, provide natural surveillance, and ensure spaces are safely lit and free of hazards. *See 1.5: Safe Streets Save Lives.*

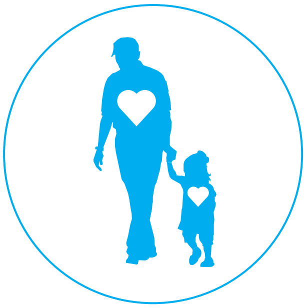


Streets are Multidimensional Spaces

Design the street in space and time. Streets are multidimensional, dynamic spaces that people experience with all their senses. While the ground plane is critical, the edges and the canopy play a large role in shaping a great street environment. *See 5.3: Immediate Street Context and 6.3.4: Sidewalks-Building Edges and Facades.*

Streets for Health

Design streets to support healthy environments and lifestyle choices. Street designs that support active transportation and integrate green infrastructure strategies improve air and water quality, can reduce stress levels, and improve mental health. *See 1.6: Streets Shape People.*



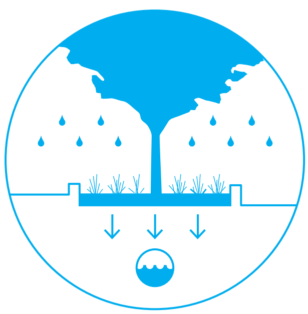
Streets are Public Spaces

Design streets as quality public spaces, as well as pathways for movement. They play a big role in the public life of cities and communities, and should be designed as places for cultural expression, social interaction, celebration, and public demonstration.

Streets are Multimodal

Design for a range of mobility choices, prioritizing active and sustainable modes of transport. Safe, efficient, and comfortable experiences for pedestrians, cyclists, and transit riders support access to critical services and destinations and increase the capacity of the street. *See 1.7: Multimodal Streets Serve More People.*

Streets as Ecosystems



Integrate contextual green infrastructure measures to improve the biodiversity and quality of the urban ecosystem. All designs should be informed by natural habitats, climate, topography, water bodies, and other natural features. *See 1.4: Streets for Environmental Sustainability, 7.2: Green Infrastructure, and 5: Designing Streets for Place.*

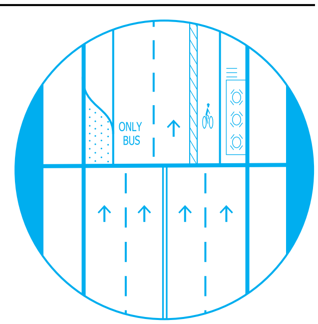
Great Streets Create Value

Design all streets to be an economic asset as well as a functional element. Well-designed streets create environments that entice people to stay and spend time, generating higher revenues for businesses and higher value for homeowners.[1] *See 1.3: The Economy of Streets*

Streets for Context

Design streets to enhance and support the current and planned contexts at multiple scales. A street can traverse diverse urban environments, from low-density neighborhoods to dense urban cores. As the context changes, land uses and densities place different pressures on the street, and inform the design priorities. *See 5: Designing Streets for Place.*

Streets Can Change



Design streets to reflect a new set of priorities that ensures appropriate distribution of space among different users. Push boundaries, try new things, and think in creative ways. Implement projects quickly using low-cost materials to help inform public decision making, allowing people to experience and test the street in different ways.

NAME SLIP
Golden
N.C.E.R.T
C.B.S.E.
KING
CHAMPION BOOKS
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5

Designing Streets for Place

Designing streets for place means considering the local culture and context. The specific characteristics of each site should help identify the uses and functions the street design must support. Shape streets to improve not only the built, but the natural, social, cultural, and economic environments. Whether changing the configuration of an existing roadbed or planning new neighborhoods, street design must always carefully consider the nature of its context. Streets have the power to drastically catalyze change in neighborhoods, or to enhance, protect, and improve what is already there.

Consider local culture and climate to ensure that the streets support daily routines, rituals, and behaviors. Provide access to new mobility choices and invite people to feel comfortable in their neighborhoods at all times of the day. Analyze what the street means, as a place, to the people who live and work nearby. Document how and when they use the street. Engage local communities and involve them in the process of transformation to ensure the adoption and long-term stewardship of the street.

As contexts change over time, mobility needs, activities, and behaviors will shift, and street designs should be chosen to best support current and future community goals and priorities.

New Delhi, India

5.1 | Defining Place

Each of the following categories contributes to defining the place within which a street project is occurring. They can, in turn, be impacted by street planning and design decisions.

Consider the various aspects of local culture and context throughout the design and implementation process to ensure contextually sustainable streets.

Built Environment

The built form and fabric of a city is made up of constructed spaces and places such as streets, buildings, parks, and transportation systems. Streets provide the continuous network that connects the many constructed environments, providing the infrastructure to facilitate mobility, critical services, and human activity. Use the scale of buildings and blocks that frame each street to inform its character and the appropriate mix of uses it should support. Transportation facilities provided within the street shape mobility and travel decisions, directly and indirectly impacting environmental quality, public health and safety, and quality of life.

Natural Environment

In urban areas, the larger natural environment may include habitats, local ecosystems, and green and blue systems. Identify local hazards and levels of pollution to help prioritize strategies for improving the natural environment. In the face of climate change, design street networks to respect, protect, embrace, and enhance ecological systems, natural topography, and water bodies, and to manage local climatic conditions.

Social and Cultural Context

Streets can allow people to live their public life in a city. Design streets to inform a sense of place in each neighborhood, embedding historical and cultural meaning for communities. Identify how unique customs and local climates influence people's behavior, when they use their streets, and what makes the space distinctive. While each place has varying levels of involvement by local citizens, facilitating participatory planning supports long-term stewardship of these spaces. Analyze the demographic information of people who live and work in the areas to reveal the total number of residents, population densities, and the cross-section of ages, income levels, and education attainment. Ensure a thorough understanding of these social, cultural, religious, and ethnic environments to shape context-sensitive streets.

Economic Environment

Local economic considerations inform the type, identity, and quality of sustainable street projects in the city. The level of economic development, political concerns, and investment priorities shape the rate of urbanization, patterns of built form, reliability of transit service, and trends of private car ownership. Analyze the economic environment and identify the types of businesses and industries that use urban streets, and the number of jobs they support. Document accessible transportation options and each household's ability to pay for them. Use these considerations to inform the local street designs so that they support and enhance long-term equity and economic sustainability.

5.2 | Local and Regional Contexts

Demographics

Analyze who lives, works, and visits the area. Identify areas with high proportions of vulnerable populations such as seniors, children, people with disabilities, or those disadvantaged through other socio-economic factors.

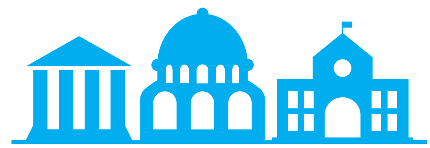
Work with local constituents to ensure that a street project reflects and supports citywide goals and community priorities.

Density

Analyze population densities, including the number of residents and concentration of jobs. Note their geographic locations and analyze trends and projections to understand future change. Document the relationship of densities and access to collective transport.

Support investment in facilities for sustainable mobility to increase the capacity of the street and serve more people.

Prioritize projects that will impact the largest number of people or where the need is the greatest.



History and Culture

Local culture will impact the nuances of how communities use and relate to their streets.

Identify how local cultures, religions, and historically significant events inform how people behave in public spaces through specific rituals or activities.

Understand each project's local context to ensure culturally appropriate community engagement processes and project outcomes.

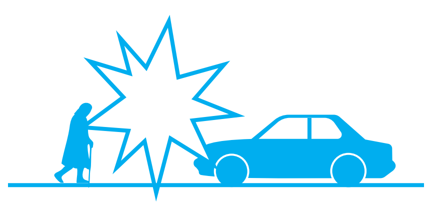
Consider how activities such as markets, vendors, bazaars, cafés, and other cultural activities can enhance a sense of place.

Mix of Uses and Destinations

Identify the mix of land uses and map important destinations that attract large numbers of people, such as job centers, parks, cultural and educational institutions, waterfronts, schools, playgrounds, transit stations, and critical services.

Ensure street networks provide sustainable mobility options between communities and important destinations.

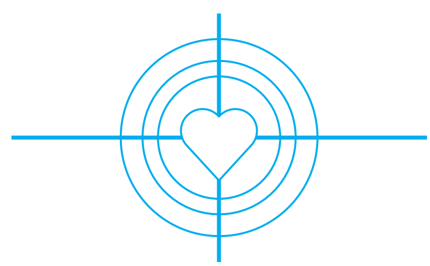
Design streets to serve and attract a diverse set of uses and activities, to enhance adjacent uses, and to become destinations in themselves.



Road Safety

Document existing speed limits, average speed traveled, and areas with high concentration of traffic crashes and fatalities.

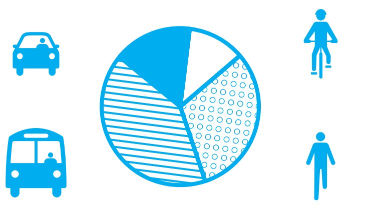
Lower speed limits, reduce design speed, propose slow zones, and identify locations to implement traffic calming strategies. Create pedestrian-only spaces, shared streets, or transit malls in suitable contexts.



Public Health

Identify geographic areas with high concentrations of chronic diseases and related hazards such as air, water, or noise pollution, or unattended waste.

Prioritize strategies that reduce pollution and promote clean and active modes of transportation. Designate freight travel routes that avoid residential areas. Ensure all neighborhoods are provided with street cleaning services and facilities, focusing especially on streets with high waste volumes.

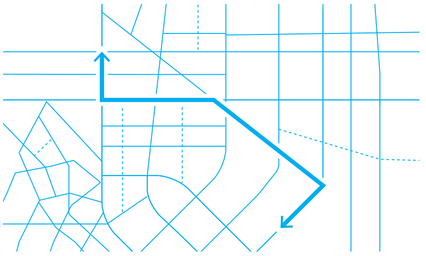


Access and Mobility

Measure existing mode share, noting shifts at different times of the day and week. Identify areas that lack access to collective transport, cycle, and pedestrian infrastructure.

Design street networks to support desirable mode share goals. Prioritizing infrastructure investments that ensure walking, cycling, and collective transport are more enticing choices than private car use.

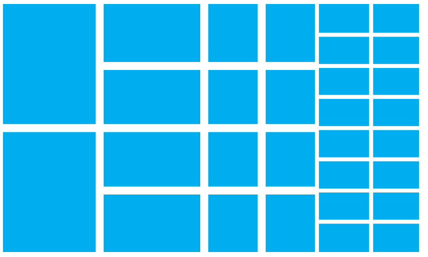
Promote car and bike share programs, develop pricing strategies, and manage networks to achieve desirable mode share targets.



Street Networks and Connectivity

Consider the existing and potential role of each street in the larger network. Note how and where networks for different modes of mobility overlap. Identify critical citywide or regional connections along specific corridors and determine how local needs change with context.

Plan, organize, and retrofit street networks to prioritize direct, safe, and convenient walking, cycling, and collective transport access and connectivity. Support connections between different modes of mobility by providing comfortable facilities at transfer points.



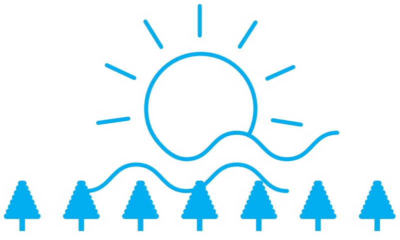
Block Sizes

Measure block sizes in the urban fabric and identify how these impact walkability.

Design new street networks to keep blocks small, promoting a walkable city that offers multiple route options.

Identify where large existing blocks can be broken down in scale with safe and well-designed paths and laneways to increase permeability and connectivity for pedestrians and cyclists.

When large blocks cannot be reduced in size, identify areas where mid-block crossings can increase permeability within neighborhoods.



Ecosystems and Habitats

Identify local ecosystems and areas of ecological importance to be protected and enhanced.

Ensure street networks avoid fragmentation of natural habitats. Support local ecosystems and foster biodiversity by constructing habitats within streets. Provide connectivity through landscaped streets for fauna movement, seed and pollen dispersal, and plant migration.

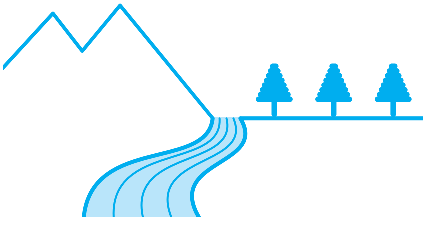
Natural Disasters

Analyze climate and frequency of extreme weather events, noting areas vulnerable to natural disasters.

Plan local infrastructure and support services to manage droughts, heavy rains, and snow falls.

Consider renewable energy sources for street lighting and emergency services.

Identify strategies and materials to support resilience in areas vulnerable to natural disasters, and designate clearly communicated emergency routes.



Geographic Features

Document topography, water bodies, and other natural features to inform new or transformed street patterns.

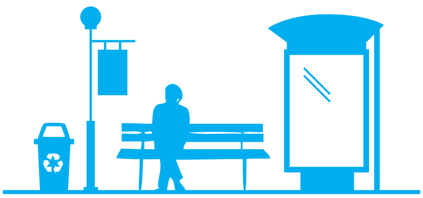
Encourage street networks to follow natural topography and geographic features in order to avoid any adverse effects on natural resource areas. This can save costs on cut and fill, assist in stormwater management, and enhance a sense of place.

5.3 | Immediate Context

Street Activity

Document the types of activities occurring on the street, noting specific locations. Measure the site at different times of the day, week, and year noting how long people spend there and whether they are sitting, playing, shopping, or partaking in other activities. Note areas where these activities block clear paths.

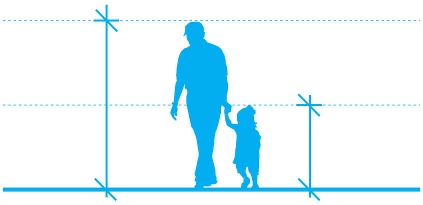
Strategically locate dedicated space and facilities within the street to entice a variety of activities while keeping the space safe, healthy, vibrant, and accessible.



Street Furniture

Locate and count street furniture such as seating, lighting fixtures, bus shelters, wayfinding signage, cycle racks, and cycle share facilities.

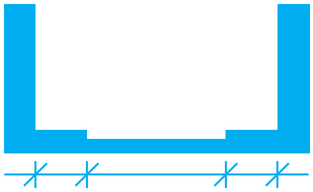
Carefully plan street furniture design and locations to meet the desirable street activity patterns and needs. Ensure the placement of street furniture maintains clear paths along sidewalks for unobstructed and accessible movement, and clear paths on roadbeds for emergency vehicles and city services.



Human Scale

Observe and note building edges, street furniture, and overall street scale in reference to the human scale and human usage.

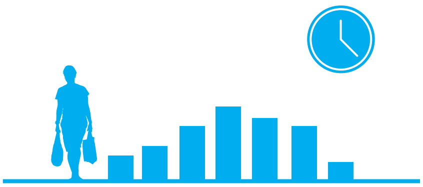
Design the street to respond to the human scale. Promote and incentivize human-scale building edges. Align street lighting, wayfinding, and signage to human eye level, and design street furniture to accommodate universal accessibility.



Right-of-Way

To identify what changes are possible, first measure the street widths and note dimensions of areas dedicated to different users. Measure at multiple locations when widths are inconsistent.

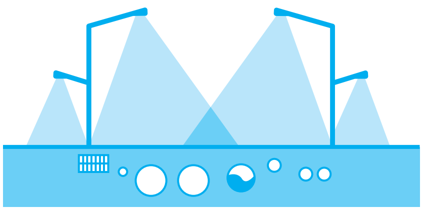
Change street geometry to appropriately distribute the limited space among different users. Prioritize space for pedestrians, cyclists, and collective transport. Include space for green infrastructure and other non-mobility activities and functions wherever possible.



Mobility Mode Share

Measure the existing mode share along the street to understand how it is used. Note how user counts vary at different times of the day, week, or year, or according to the specific operational strategies in use.

Design the street to promote safe, accessible, efficient, and comfortable walking, cycling, and collective transport over private car use. Accommodate easy transfers from one travel mode to another.

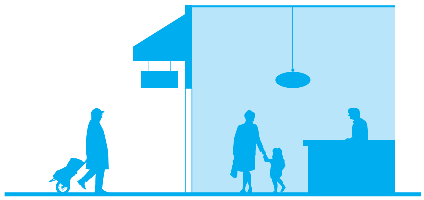


Utilities and Infrastructure

Document location and type of lighting and other utilities that impact street design. Identify obstacles to safe pedestrian movement, and note if obstructions are fixed or movable.

Locate areas with insufficient lighting, and identify areas prone to flooding or standing water.

Design streets to improve energy efficiency, water management, and air quality. Provide safe and quality lighting to support a sense of place.



Building Edges and Uses

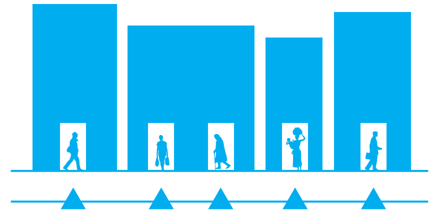
Observe and document the building edges and any setback areas. Note different use types on the ground floor, and assess how those support or hinder street activity.

Design streets to support the uses in the adjacent buildings. Provide clear paths, space for street furniture, and designate areas for ground floor uses to extend into the street at strategic locations.

Transparency

Measure transparency levels of the ground floors of buildings. Note long stretches of blank facades, fences, or building setbacks, and the overall sense of safety and surveillance.

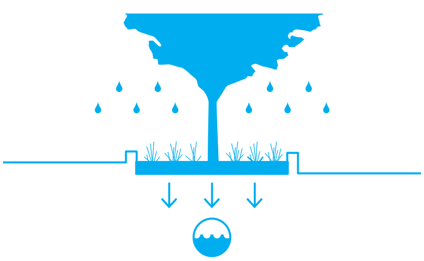
Design streets to support the visual extension of ground floor uses into the public realm, adding life and interest to the street. Provide landscaping, artwork, and other engaging elements to reduce the negative impact of blank facades or inactive building setbacks.



Entrances

Document the location and frequency of entrances to the adjacent buildings, noting their uses. Identify locations with heavy pedestrian volumes at various times of the day.

Increase pedestrian spaces and add supporting street furniture near, but not in the way of, busy entrances. Promote frequent and active entrances and ensure clear paths appropriate for accommodating pedestrian volumes.



Green Infrastructure

Locate existing trees and planted areas. Take note of the local climate, planting seasons, and species. Identify the water table, sub-surface conditions, and utilities.

Include trees and planted areas in street design to improve air quality, provide shade, improve water management systems, support local ecosystems, and create living streets. Use native species to plant streets and improve the microclimate.

Local Climate

Consider local climates, average temperatures, and frequency of extreme weather events.

Include protection from extreme heat, heavy rains, snow, or strong winds. Provide shade to minimize urban heat island effect and improve pedestrian comfort in warmer climates. Design for solar exposure and snow removal in colder climates. Prepare street infrastructure and materials to adapt to seismic and geologic changes, and other natural disasters.

Curbside Management

Document the number of dedicated and illegal on-street parking spaces, noting cost per hour and any use restrictions. Identify loading spaces and truck routes, as well as any current management strategies.

Develop curbside management strategies that include purpose-based zones, time limits for parking and deliveries, and pricing strategies. Remove on-street parking spaces for other uses when competing needs and priorities are identified.

5.4 | Changing Contexts

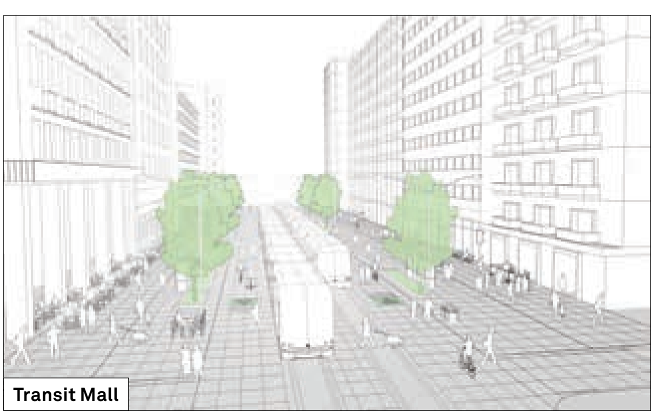
One Street, Different Contexts

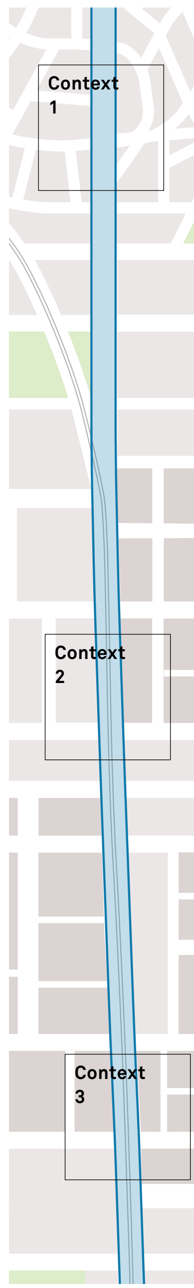
Context is a crucial, yet often overlooked, factor in designing streets. Densities, land uses, and travel characteristics can shift as the street traverses the city from one neighborhood to another. Street design should respond to and affect the desired character of the public realm. As the needs and uses along a street change, street designs should respond and adjust accordingly.

Below, a single street is illustrated at three points along its length, depicting three different potential designs that respond to the adjacent contexts.


Neighborhood Main Street


Central Two-Way Street


Transit Mall



Context 1: Neighborhood Main Street

- A mix of residential and commercial ground floor uses line each side of the street in a low-to-mid density context.
- Transit is provided in mixed traffic.
- Dedicated cycle tracks are created in both directions.
- On-street parking is maintained.
- Green infrastructure and trees are added.
- Transit stops are provided on boarding islands.

Context 2: Central Two-Way Street

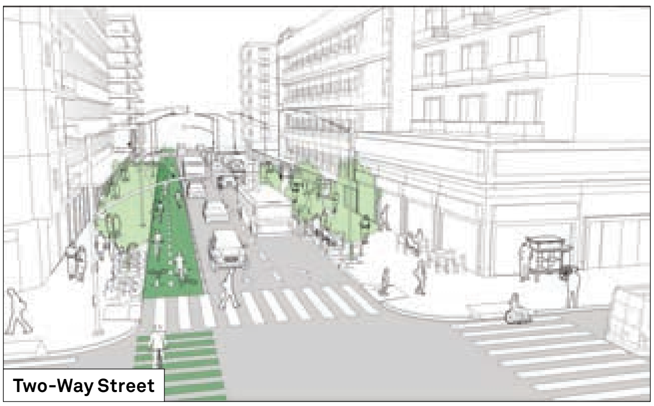
- Transit lines run along a dedicated center-running transit lane.
- Side-loading transit stations are connected with raised crossings.
- Parking is exchanged for wider sidewalks to support higher pedestrian volumes.
- One travel lane is maintained in each direction with slow speeds and limited access, and is shared with cycles.

Context 3: Transit Street

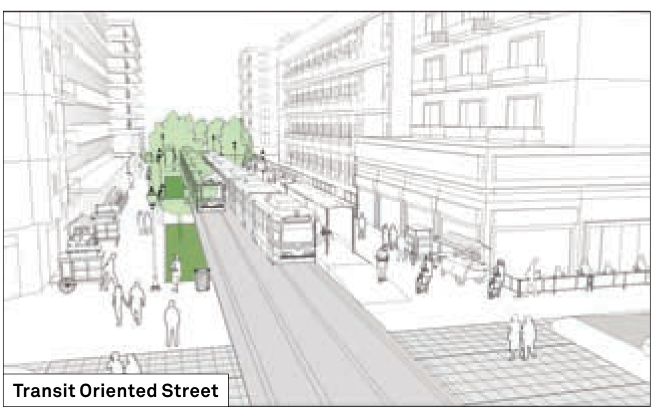
- The street transitions into a transit mall in a high-density context, serving large volumes of pedestrians.
- Commercial activity extends from storefronts, and new street furniture supports a high-quality public realm.
- Collective transport moves through the space at slow speeds, allowing all users to safely navigate the mall.
- A mix of uses keeps the space active and engaging through the day and evening.

One Context, Different Priorities

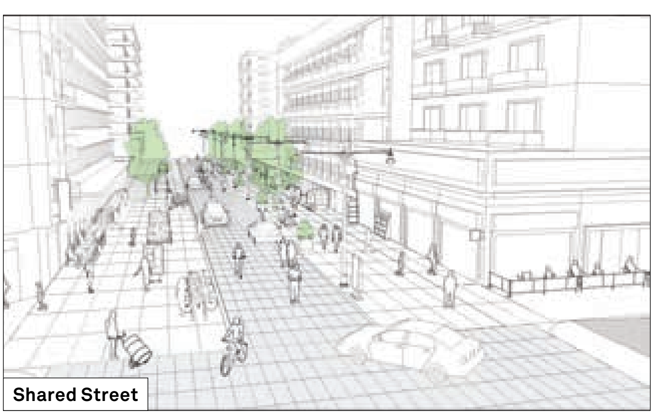
Understanding the existing conditions of a street is important in guiding responsible street design. It is equally important, however, to identify the functions and uses desirable for the future. Current street types can, and often should, transform from one type to another in order to support long-term citywide policy goals. Three possible alternatives for a given street with a specific context are illustrated below. Each example reflects a different set of priorities and desired outcomes identified during the planning and design process.



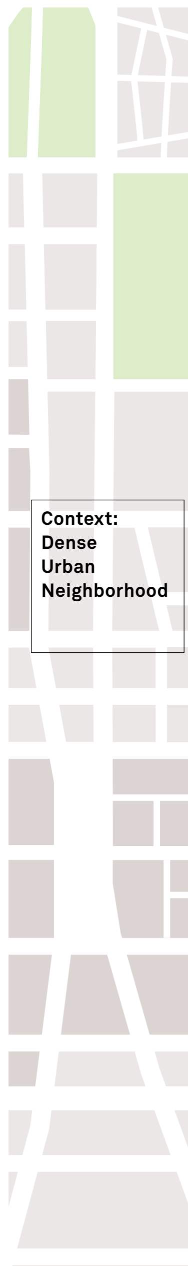
Two-Way Street



Transit Oriented Street



Shared Street



Existing Context

- A dense, mixed-use urban neighborhood.
- Two lanes of traffic in each direction.
- Angled parking and narrow sidewalks.

Option 1: Two-Way Street with Bidirectional Cycle Track

- Travel lanes are narrowed and reduced.
- Parallel parking is kept on one side.
- Collective transport remains in mixed traffic.
- Transit stops improve accessible boarding.
- A two-way cycle track is included on one side.
- Sidewalks are widened.
- Parklets, trees, and loading bays alternate with parking spaces.

Option 2: Transit-Oriented Street

- Mixed traffic is removed and replaced with transit-only lanes.
- Rain gardens and trees are added to support the citywide green infrastructure plan.
- Spaces for seating, shade structures, vendors, and transit stops are included on each block.
- A continuous surface with wide, clear paths allows commercial activity to extend from adjacent buildings and ground floors.

Option 3: Shared Street

- The street is redesigned as a shared street, as part of a network of pedestrian-priority spaces in the city center.
- A continuous surface prioritizes pedestrians and invites private motor vehicles and loading vehicles to use the space at slow speeds.
- Street furniture and landscape improve the quality of the public realm.

6

Designing Streets for People

People use urban streets for mobility or for stationary activities, for leisure or for work, out of necessity or by choice. People of all ages and abilities experience streets in different ways and have many different needs. Whether sitting, walking, cycling, using collective or personal transport, moving goods, providing city services, or doing business, the various activities that streets accommodate and facilitate shape the accessibility and livability of the city.

The types of users and the overall volume of people on a given street depend on many variables such as the time of day, the size of the street, the urban context, and the local weather. Each user moves at a different speed and takes up a different amount of space within the limited geometry of the street. Therefore, the overall capacity of the street will be determined by the mix of transportation modes that the street design accommodates.

Design streets to balance the needs of diverse users in order to shape an enticing environment that ensures access, safety, comfort, and enjoyment for everyone.

Paris, France

6.1 | A Variety of Street Users

In most cities, streets constitute the largest percentage of public property, and this space must be equitably distributed between the needs of the many different users of urban streets. Designs must accommodate people walking, cycling, taking transit, enjoying public spaces, providing city services, doing business, or driving. This chapter identifies design elements and strategies to support safe and inviting spaces for the variety of people using urban streets.

Pedestrians

Pedestrians include people of all abilities and ages, sitting, walking, pausing, and resting within urban streets. Designing for pedestrians means making streets accessible to the most vulnerable users. Design safe spaces with continuous, unobstructed sidewalks. Include visual variety, engage building frontages, design for human scale, and incorporate protection from extreme weather to ensure an enjoyable street experience.

Cyclists

Cyclists include people on bicycles, cycle-rickshaws, and cargo bikes. Facilities should be safe, direct, intuitive, clearly delineated, and part of a cohesive, connected network to encourage use by people of all ages and confidence levels. Cycle tracks that create an effective division from traffic, are well coordinated with signal timing, and are incorporated in intersection design form the basis of an accessible and connected cycle network.

Transit Riders

Transit riders are people using collective transport such as rail, bus, or small collective vehicles. This sustainable mode of transportation dramatically increases the overall capacity and efficiency of the street. Dedicated space for transit supports convenient, reliable, and predictable service for riders. Accessible boarding areas promote safe and equitable use. The space dedicated to a transit network should be aligned with demand, meeting service needs without sacrificing streetscape quality.

Motorists

Motorists are people driving personal motor vehicles for on-demand, point-to-point transportation. This includes drivers of private cars, for-hire vehicles, and motorized two-and three-wheelers. Streets and intersections must be designed to facilitate safe movement and manage interactions between motor vehicles, pedestrians, and cyclists.

Freight Operators and Service Providers

Freight operators and service providers are people driving vehicles that move goods or conduct critical city services. These users benefit from dedicated curb access and allocation of space for easy loading and unloading as well as dedicated routes and hours of operation. Emergency responders and cleaning vehicles need adequate space to operate, which must be accommodated while ensuring the safety of all other street users.

People Doing Business

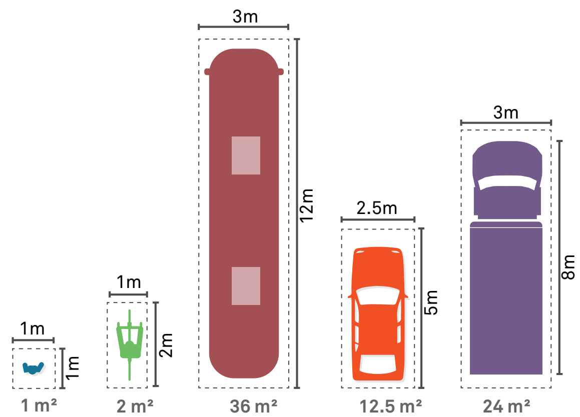
People doing business include vendors, street stall operators, and owners or renters of commercial storefronts. These users provide important services that support vibrant, active, and engaging street environments. Adequate space should be allocated to these uses. Provide regular cleaning, maintenance schedules, power, and water to support commercial activity and improve local quality of life.

6.2 | Comparing Street Users

Comparing the size of and space occupied by different street users reveals the advantages of designing streets for transit, cycling, and walking. Providing high-quality facilities for these spatially efficient, affordable, and sustainable transportation modes allows the same street to accommodate more people. Reducing the amount of space devoted to movement and storage of private vehicles maximizes the amount of space available for other activities that add to the quality of the street.

Scale and Size

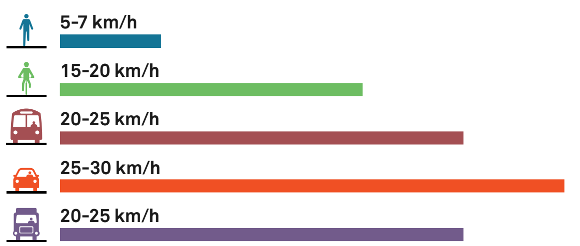
People and vehicles take up different amounts of space when they are moving. Each needs an operational envelope that feels comfortable and supports safe movement. While walking and cycling use the least amount of space for movement and storage, and have the greatest flexibility, the comfort and safety of these modes is heavily influenced by the amount of space available to them.



Operational envelope for different users and vehicles.

Speed of Movement

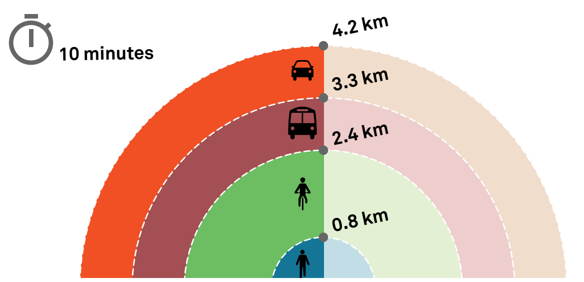
Vehicle speed is a key risk factor in road traffic injuries and death. High-impact speeds drastically increase the risk of severe injury or death in the event of a crash. People moving at low speeds have more time to observe the street around them, have more reaction time, and have very short reaction distances. Street design, human perception and comfort, and the activity of other people all impact moving and operating speeds.



Average speeds for different users and vehicles.

Travel Time and Distance

Understanding how far a person can travel in 10 minutes provides a basic measure of the number of destinations easily available to them. A person walking in a city center has access to many more destinations than a person driving in a low-density setting. Planning around 5-, 10-, and 15-minute distances, especially for transit stops and neighborhood cycle and walking networks, can help inform the potential of a street to become an important part of the active transportation network.



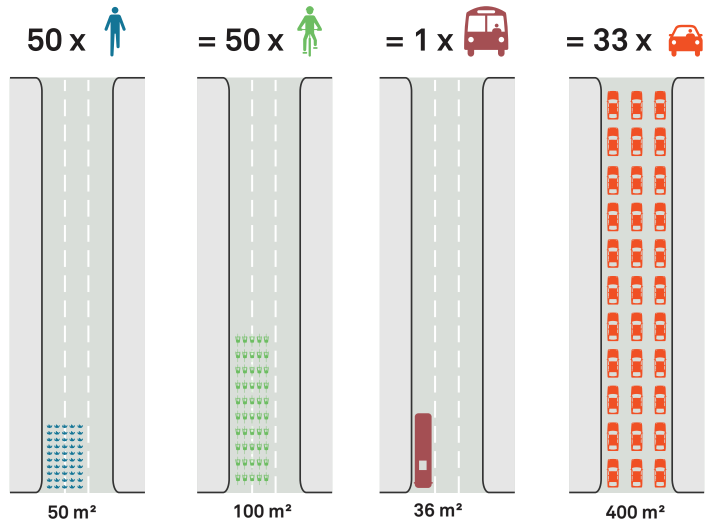
Average distance traveled by different users and vehicles in 10 minutes.

Mass and Vulnerability

Mass plays a very prominent role in the event of a crash. When a heavy vehicle collides with a lighter vehicle, the occupants of the light vehicle are far more at risk of sustaining severe injury. Pedestrians, cyclists, and motorcyclists have the greatest risk of severe injury when colliding with a motor vehicle and are commonly referred to as vulnerable users. Compared with other street users, this group is particularly exposed to injury as they are not protected by a vehicle shell.

Space Occupied by 50 People

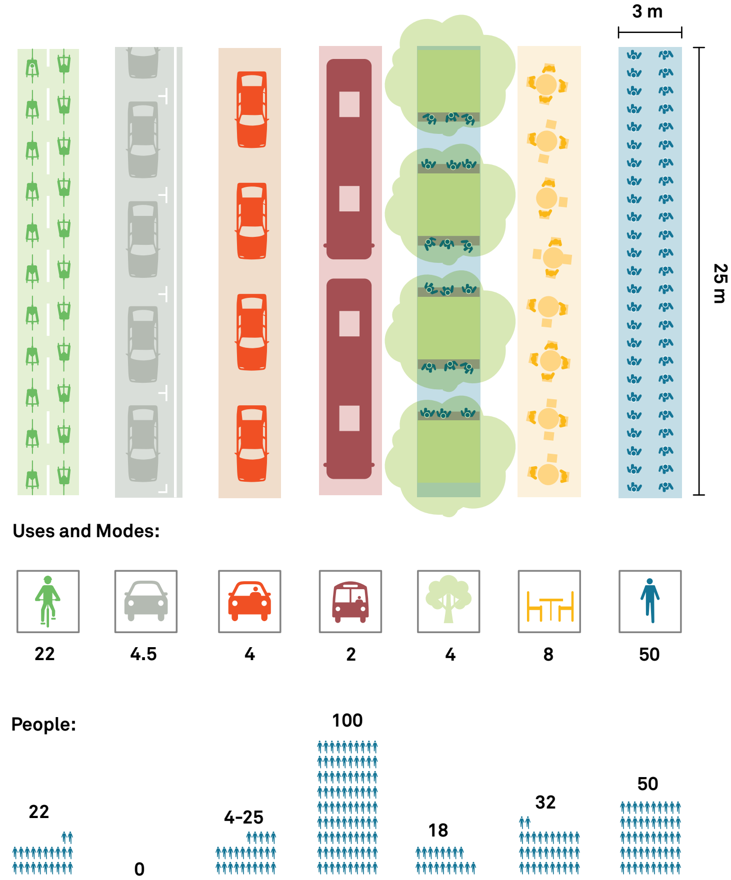
While a bus needs three times as much space as a car, its carrying capacity per lane is unrivaled among other on-street modes. As land in urban areas becomes increasingly scarce, use the space within the street most efficiently to serve the largest number of people.



Space Occupied by Uses, Modes, and People in a Given Area

Analyze the way street designs allocate space among different users in order to support a variety of activities and modes of transportation.

Consider how the same 3 m x 25 m strip can be used for various uses and by different numbers of people.



6.3 | Designing for Pedestrians

6.3.1 | Overview

Every trip begins and ends with walking, and therefore everyone is a pedestrian on a city's street at some point. Providing continuous and unobstructed clear paths ensures walkable neighborhoods for everyone. Each sidewalk's clear path should be complemented with active street edges and accessible facilities to make the journey comfortable and engaging.

Cities are places for people, and they use streets for not only walking, but also resting, sitting, playing, and waiting. This requires making people the highest priority in street design, with careful consideration for the most vulnerable users: the young, the elderly, and those with diminished perceptual or ambulatory abilities.

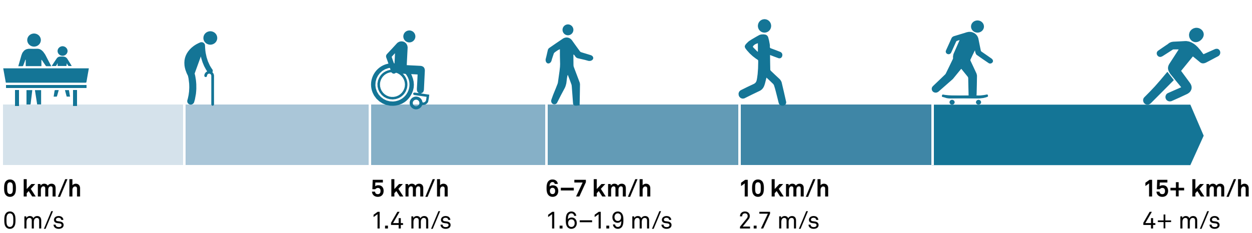
The types and volumes of people using a given street will depend on the surrounding land use and density, key destinations, and time of day. Without an enclosed vehicle and moving at slower speeds, pedestrians engage all of their senses when using urban streets. How people use streets will depend on the space available to them, the facilities that offer a moment to pause, and the overall street experience.

Street designs should always prioritize safe facilities for pedestrians, and measure their success from the pedestrian perspective. A walkable city that is easy and safe to navigate offers a level of independence and equity to its citizens.

Pedestrians need continuous and unobstructed moving paths, well-lit spaces, inviting building edges, shaded places to rest and walk, and wayfinding signs for a safe and comfortable street experience.

Speed

Walking speed depends on age and ability, as well as the purpose and length of the trip. It is influenced by pavement quality and topography, and the size, altitude, and climate of the city. While walking speeds range from **0.3 m/s–1.75 m/s** or **1 km/h–6 km/h**, people who walk with assistance—in form of canes, walkers, or other devices—are limited to speeds of **0.3 m/s–0.5 m/s**. People with motorized wheelchairs and other personal mobility devices may be faster, and people using skates or skateboards can reach speeds near that of cycles. Ensure that urban streets allow for a variety of speeds, whether someone is walking quickly with purpose, meandering slowly, pausing for a rest, or stopping to talk, sell goods, or eat. Accommodate fast walkers with low delay, and slow walkers with protection from vehicle conflicts and places to rest during long crossings. Consider these variables when determining lane configuration, signal timing, and sidewalk width.

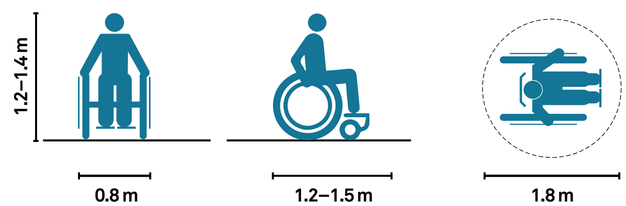


Variations

An alert adult who can see clearly, walk confidently in any environment, and react quickly to motor vehicles is the exception rather than the rule, and should not be used as the design case. Instead, select street attributes using a variety of "design pedestrians," discussed in more detail below. All pedestrians benefit from shorter crossing distances, refuge areas, ample room to wait at intersections, intersection control that prioritizes their movement, and sidewalks that are laterally and vertically separate from all but the lowest-speed and lowest-volume traffic. Provide enough room on busy sidewalks for people walking in groups to pass each other. Use pedestrian countdown signals and minimize wait time while maximizing pedestrian signal phase length.

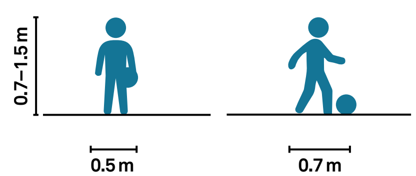
People with Disabilities

Integrate the needs of people who have impaired vision or hearing, people in wheelchairs, and those who walk with canes or gait trainers. Sidewalks must be wide enough to allow two people in wheelchairs to pass one another, with clear paths on low-volume streets being wider than **2 m** and never less than **1.8 m**. Clear paths should be unobstructed, level, and with a smooth surface. Design accessible ramps with shallow slopes at all crossings, preferably **8%**, and provide cut-through paths in medians, pedestrian refuge islands, and corner islands.



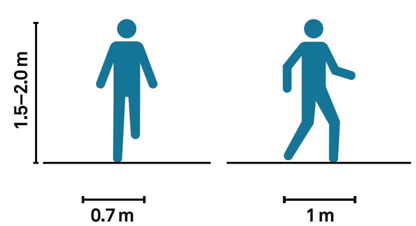
Children

With a world population that includes two billion children under 15 years old, all streets should be fundamentally safe for children traveling with or without adults. Children are less capable of judging speed than adults, placing the responsibility of providing safe movement options on designers and drivers. Their shorter height and slower walking speed must be accounted for in pedestrian crossing design and signal timing. Safe intersections for children have low through-traffic speeds, signals timed for a slow walking speed, very low turning speeds, and highly visible pedestrian crossings. Designs should indicate to drivers that children are present on neighborhood streets. The design of all streets must account for children by limiting the speed of vehicles and introducing efficient pedestrian infrastructure, especially signals.



Adults and Seniors

The global population is aging, but a large number of streets do not accommodate the needs of seniors. As pedestrians, older adults are a small portion of the population but account for a high percentage of road deaths. Danger increases when the pedestrian signal phase is too short, when there are broken or missing pedestrian ramps, and when markings are faded or hard to see. Design safe streets for seniors by providing refuge islands for every two to three traffic lanes, and providing curb extensions to reduce crossing distances and improve visibility at the pedestrian crossing. Prevent parking within **6 m** of pedestrian crossings to increase visibility.



6.3.2 | Pedestrian Networks

Pedestrian networks must be safe, comfortable, and enjoyable. Compared to other users, pedestrians cover less ground in the same amount of time, and experience the street the most intensely.

Moving without the protection of an enclosed vehicle, pedestrians engage all senses and are the most vulnerable users.

Look at the finest grain of the city fabric and the various types of pathways that can work together to create a comprehensive and continuous network. Design pedestrian networks to be:

- **Connected and Permeable**
- **Accessible and Comfortable**
- **Safe**
- **Relevant to Context**

Connected and Permeable

Connected

To be useful, sidewalks and pedestrian crossings must offer a continuous clear path. Even short stretches of sidewalk that are unpaved, uneven, obstructed, or that end abruptly disincentivize walking and create serious barriers for wheelchair users.

Permeable

Create pedestrian links in order to shorten walking routes when possible. Paths and streets that end in cul-de-sacs should be extended to connect to nearby streets. Encourage the creation of pedestrian links through large blocks to achieve a finer-grain urban fabric and improve connectivity.

Choice

Provide multiple routes to move between key destinations. If one path is closed for maintenance, others should still be available.

Key Destinations

Carefully design pedestrian experiences within walking distance of key destinations such as transit stations, parks, schools, commercial districts, and neighborhood main streets. People are more likely to walk from one destination to another if the experience is convenient, comfortable, and enjoyable. Areas around key destinations and transit stops should include spaces that allow groups of people to congregate without blocking the paths of others.

Accessible and Comfortable

Accessibility

All streets should be universally accessible, accommodate different walking speeds, and be legible for all users. Pay particular attention to the needs of children, the elderly, and people with disabilities.

Capacity and Comfort

Ensure that sidewalk networks, hierarchy, and width relate to their context. Sidewalks should not require people to walk in single file, but allow pairs and groups to comfortably walk past each other. Downtown areas need wide sidewalks and clear paths for higher pedestrian volumes at peak periods. Neighborhood streets should allow space for outdoor uses and commercial activities, while residential streets with narrower clear paths should include additional landscaping.

Safe

Pedestrian Spaces

Pedestrian spaces must be safe for all users at different times of the day. They should be well-lit, provide accessible slopes and gradients, be free of obstructions, and offer eyes on the street for natural surveillance and crime prevention.

Intersections

Intersection are critical nodes in a network in which pedestrians are exposed to the highest risk of fatality and injury. Provide visible, clear, short, and direct crossings at intersections. Install curb extensions and refuge islands to shorten crossing distance and provide protected areas for pedestrians waiting to cross. Crossings should always be marked, and when possible raised, for increased safety.

Relevant to Context

Human Scale and Complexity

Design facades and edges of buildings or spaces that define the pedestrian network to be engaging and interesting. Support varied building heights, architectural details, signage, entrance spacing, transparency levels, and landscaping to break down the scale and rhythm of the block and make walking distances feel shorter. Include a variety of shading and lighting devices on building facades to provide a comfortable walk.

Character and Identity

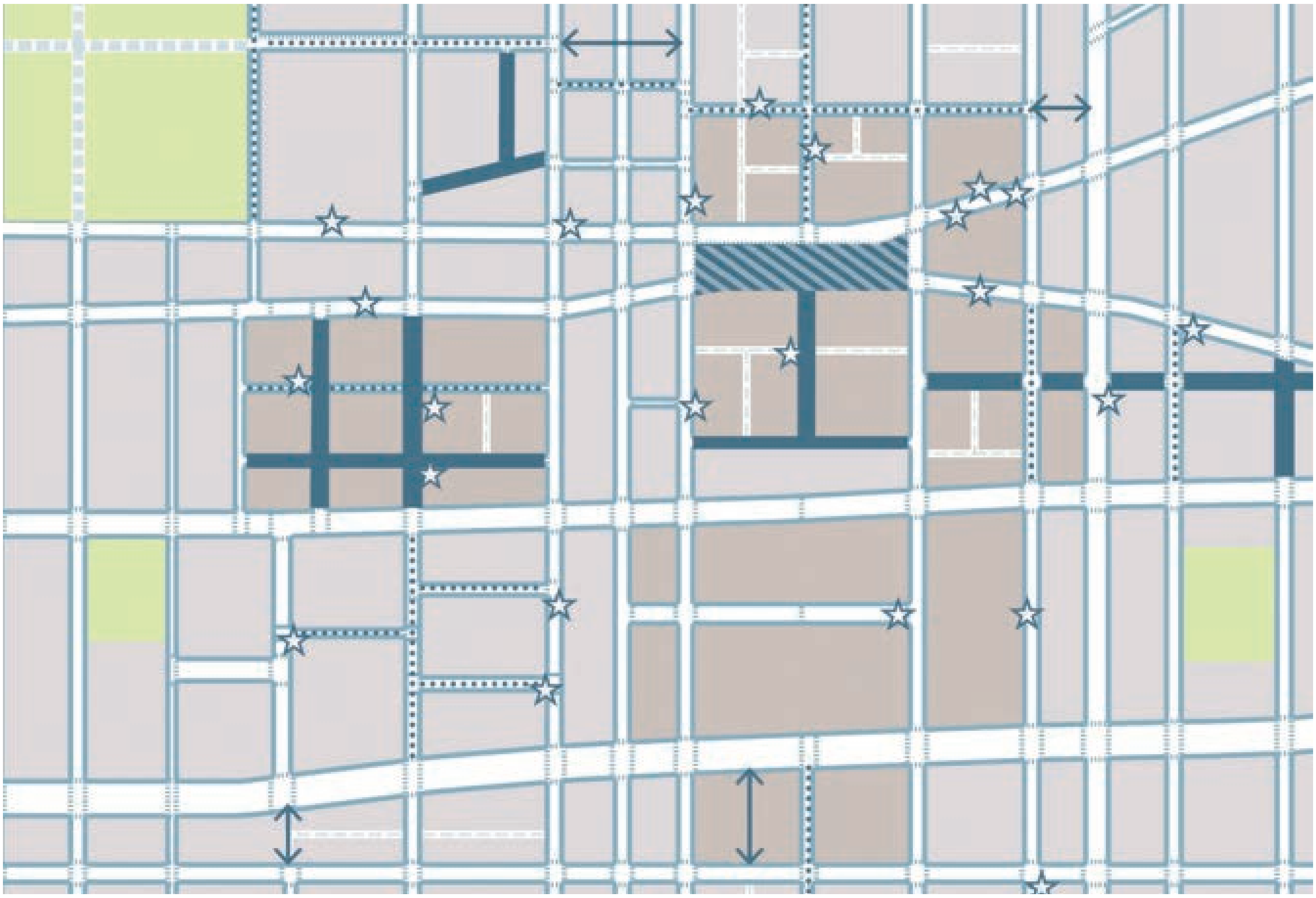
Iconic streets invite the opportunity for unique street furniture, wayfinding, landscaping, paving, signage, and lighting. Historic areas, promenades, and well-known corridors can strengthen the character of a neighborhood through the design of the street.

Topography

Steep elevation changes can limit street network connectivity and complicate access to critical services and key destinations. Combine steps and ramps with rest areas and landscaping.

Green Corridors

Opportunities to incorporate trees and landscaping should be identified throughout the city, along with particular corridors for additional greening. Green corridors should be provided on streets surrounding parks, large boulevards, central urban areas, and local neighborhood streets. Select native species to best suit local climates. Green corridors can help reinforce the character and identity of a neighborhood. *See 7.2: Green Infrastructure.*



Pedestrian Networks: Fine-grain pedestrian networks with a variety of pedestrian-priority spaces support a walkable city. Continuous sidewalks that are free of obstructions, frequent at-grade crossings, and small blocks allow pedestrians to conveniently and safely reach their destinations. Interesting and permeable building edges designed with human scale in mind provide an engaging and enjoyable walking experience.

New Delhi, India. A narrow laneway provides a convenient shortcut between neighborhoods.

São Paulo, Brazil. Parklets on a neighborhood sidewalk provide a place to pause.

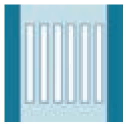
Paris, France. Wide sidewalks provide space for promenading and people watching.

6.3.3 | Pedestrian Toolbox

Use the following collection of elements as a visual checklist to ensure a comprehensive approach to prioritizing pedestrians and providing universal accessibility. Items marked with an asterisk (*) are discussed in more detail in the following pages.

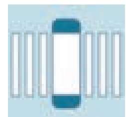
Sidewalks*

Sidewalks should be continuous and provide a clear path consistent with pedestrian volumes, but always wide enough to allow two people using wheelchairs to pass one another. Allocate space for building entrances and commercial activity outside the clear path. Street furniture, trees, and utilities should serve as a buffer between the clear path and moving traffic.



Pedestrian Crossings*

Safe and frequent pedestrian crossings support a walkable urban environment. Pedestrian crossings should be located at all intersections in addition to mid-block points where pedestrian traffic is anticipated or desire lines are observed. Support marked crossings with signals and stop controls, raised elements, refuge islands, and narrow corner radii. Slow vehicular traffic approaching pedestrian crossings.

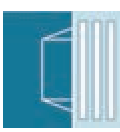


Pedestrian Refuges*

Pedestrian refuges reduce crossing distance and provide waiting areas for people who cannot cross the full width of the street in the pedestrian interval. Use pedestrian refuge islands whenever speeds and vehicle volumes make single-stage crossings dangerous for some users, and in most streets of three or more lanes of traffic.

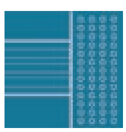
Sidewalk Extensions*

Sidewalk extensions are an extension of the sidewalk, usually at the point of the intersection, visually and physically narrowing the roadway and shortening crossing distances. They make pedestrians waiting to cross the street more visible to drivers, calm traffic speeds, and increase the available curb space for people waiting to cross. Large sidewalk extensions can accommodate street furniture, benches, vendors, transit stops, snow storage, planters, and trees.



Pedestrian Ramps

Install pedestrian ramps at every pedestrian crossing and change of level. They should be built of non-slip materials and have a maximum slope of **1:10 (10%)**, ideally **1:12 (8%)**. These ramps are critical for people pushing strollers or carts, or using wheelchairs. They should be aligned perpendicularly to the pedestrian crossing.



Guidance for the Visually Impaired

Employ strategies such as accessible pedestrian signals at intersections, tactile paving strips on sidewalks, station edges, and pedestrian ramps to facilitate accessibility for people with vision impairment. These elements provide guidance to assist blind people and the visually impaired in navigating the city.

Signage and Wayfinding

Provide consistent pedestrian signage in a clear visual language that can be universally understood. Provide information to allow users to switch between mobility modes and navigate local street networks. Illustrate walking and cycling times and distances in wayfinding signs and maps.

Pedestrian Countdown Signals

Install pedestrian signals at intersections to allow pedestrians to cross the street safely. Display crossing time duration with a numerical timer during the clearance interval. The clearance time is generally based on a **1-m/s** walking speeds applied to the total crossing distance. Since many pedestrians walk below this speed, provide frequent refuge or time the walk signal to allow for a **0.5-m/s** speed.

Lighting

Well-lit spaces are critical to pedestrian safety, creating lively, inviting spaces at night and preventing crime. Place pedestrian-scaled lighting along all streets, ensuring appropriate illumination levels and spacing to avoid dark spots between light sources. Brightness levels should be greater along commercial streets and softer in residential areas. Poles and fixtures should never obstruct walking paths. *See 7.3.1: Lighting Design Guidance.*

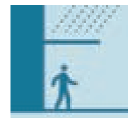
Seating

Provide frequent opportunities for people to pause and rest. Seating should have comfortable backs, offering a mix of shaded and unshaded seats suited to the local climate. Placement should allow legroom that does not block the clear path. In larger pedestrian areas, provide movable chairs and a variety of seating arrangements to invite conversation and social activity.

Water Fountains

Provide drinking fountains with fresh, potable water to offer sustainable alternatives to bottled water and ensure an essential water source in many communities. Use creative designs to encourage use, and ensure that fountains are maintained to clean and safe standards. Provide access for children and people in wheelchairs with varied heights.

Weather Protection



Incorporate awnings and canopies into building facades where possible to add shelter and character to the street, and offer protection from the weather during snow, rain, or extreme heat. Install stand-alone shade structures in larger pedestrian-only areas if shade trees are not present or are immature.

Curbs

Provide curbs to create a structural edge between the sidewalk and adjacent cycle or travel lanes. Curbs discourage vehicles from entering or blocking pedestrian areas, and many are integrated with a gutter to assist in channeling water. Curbs should not be more than **15 cm** high. They should incorporate ramps at pedestrian crossings to facilitate safe access.

Waste Receptacles

Provide conveniently available receptacles for waste to help maintain a clean and enjoyable pedestrian environment. Place waste receptacles near corners, vendors, crossings, and parklets, adjacent to clear paths. Receptacles should be sized in accordance with expected use and local collection and maintenance plans. Solar–powered compactors can increase collecting capacity in high volume areas.

Active Building Edges

Building frontage design plays a critical role in shaping the overall pedestrian experience. The design of the ground floor influences the character of the street and the level of pedestrian engagement. Frequent entrances, appropriate transparency levels, visual variation, and textures all contribute to shaping an enticing street environment.

Trees and Landscaping

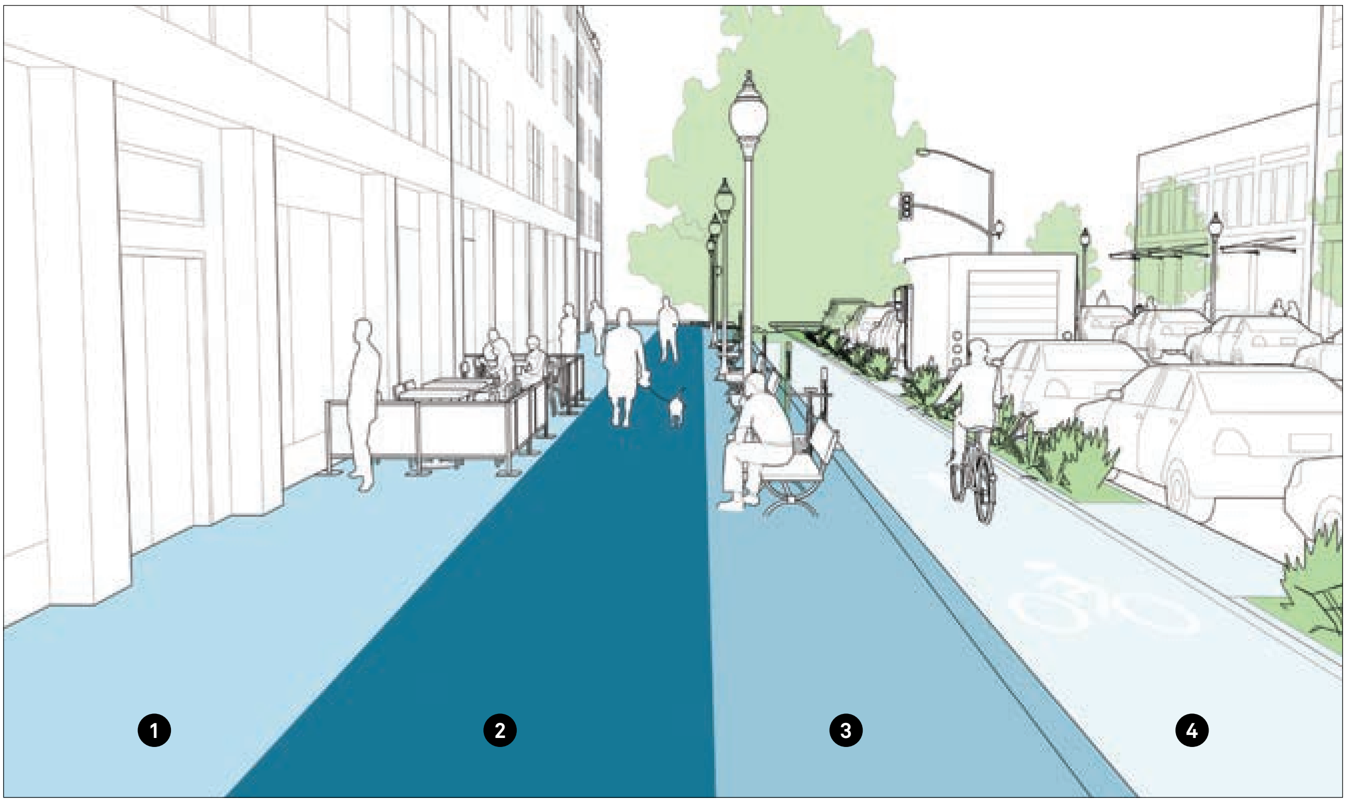
Include landscaping where possible to create a pleasant walking environment, contribute to the character of a neighborhood and encourage active transportation choices. Landscaping improves microclimatic conditions, cleans the air, filters water, and increases the biodiversity of a city, offering physical and mental health benefits.

6.3.4 | Sidewalks

Sidewalks play a vital role in city life. As a conduit for pedestrian movement and access, they enhance connectivity and promote walking. As public spaces, sidewalks serve as the front steps to the city, activating streets socially and economically. Safe, accessible, and well-maintained sidewalks are a fundamental and necessary investment for cities, and have been shown to enhance general public health and maximize social capital.

Just as roadway expansions and improvements have historically enhanced travel for motorists, superior sidewalk design can encourage walking by making it more attractive.

Curb cuts for vehicle access should be limited in areas with high pedestrian volumes, and when unavoidable, they must maintain accessible levels, slopes, and clear path minimums.



Frontage Zone

1 The frontage zone defines the section of the sidewalk that functions as an extension of the building, whether through entryways and doors or sidewalk cafés and sandwich boards. The frontage zone consists of both the facade of the building fronting the street and the space immediately adjacent to the building.

Clear Path

2 The pedestrian clear path defines the primary, dedicated, and accessible pathway that runs parallel to the street. The clear path ensures that pedestrians have a safe and adequate place to walk and should be **1.8–2.4 m** wide in residential settings and **2.4–4.5 m** wide in downtown or commercial areas with heavy pedestrian volumes.

Street Furniture Zone

3 The street furniture zone is defined as the section of the sidewalk between the curb and the clear path, in which street furniture and amenities such as lighting, benches, newspaper kiosks, transit facilities, utility poles, tree pits, and cycle parking are provided. The street furniture zone may also contain green infrastructure elements such as rain gardens, trees, or flow-through planters.

Buffer Zone

4 The enhancement or buffer zone is defined as the space immediately next to the sidewalk, and may consist of a variety of different elements. These include curb extensions, parklets, stormwater management features, parking, cycle racks, cycle share stations, and curbside cycle tracks.

Sidewalk Types

Residential Sidewalks

While residential streets require less capacity than bustling urban centers, sidewalks must always maintain a comfortable and accessible clear path. The frontage zone may vary depending upon whether buildings are set back from the street edge and how fences, front yards, stoops, or planting strips are designed. Residential sidewalks are used for walking, playing, and socializing and should include street trees and planting where possible. The furniture zone should be designed to accommodate additional play facilities or green infrastructure where possible. Curb cuts for vehicle access should be minimized.

MALMÖ, SWEDEN

This residential sidewalk in Malmö provides a clear walking path, and is lined with ground floor residential uses. Frequent entrances and front yard planting support an engaging walking experience.

Malmö, Sweden

Neighborhood Main Street Sidewalks

Neighborhood main streets include mixed-use street frontage alternating between residential and commercial uses. Main street sidewalks should accommodate moderate pedestrian volumes with large numbers of people stopping, sitting, and pausing as well as the extensions of ground floor uses. Sidewalks should be appropriate to the local climate and well lit, with frequent pedestrian seating. Curbside parking or transit facilities may require shelters or parking meters in the curb zone. The curb zone can be designed to accommodate green infrastructure.

FORTALEZA, BRAZIL

Avenida Monsenhor Tabosa was redesigned in 2014, costing 5,9 million reais, or US $1.65 million. Improved sidewalks with wide clear paths replaced 200 m of parking and service lanes along the 700-m length of the project, and new shade structures, lighting, bus stop areas, and seating opportunities improved the pedestrian experience and accessibility. Raised crossings and intersections were also included to induce speed reduction.

Av. Monsenhor Tabosa; Fortaleza, Brazil

Commercial Sidewalks

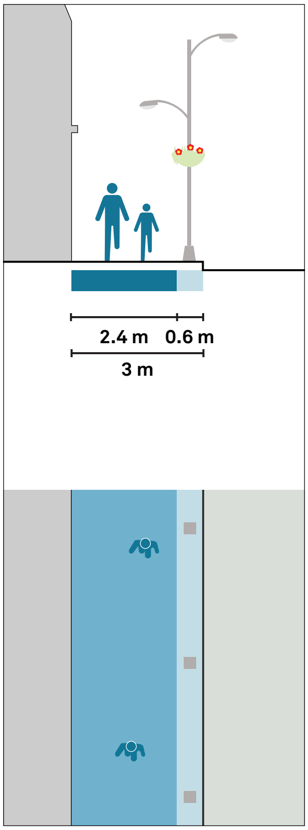
Commercial streets are characterized by large pedestrian volumes, active ground floors, street-facing entrances, commercial activity spilling onto the sidewalk, and loading activities. Commercial streets range from large streets to small alleys and laneways. The sidewalks on wider commercial corridors should have clearly defined frontage zones and street furniture zones to accommodate restaurant seating, commercial goods, benches, street planting, signs, street lights, and other necessary infrastructure. The curb zone may also include transit facilities and may have curb cuts or loading ramps for freight services.

NEW YORK CITY, USA

Broadway is one of the main commercial corridors in New York City, running 21 km down the length of Manhattan. The wide sidewalks are typically between 6–8 m wide, catering to heavy pedestrian volumes and allowing space for large street trees, bus stops, street furniture, and for commercial activities to spill out. Recent sidewalk widening expanded the width to 14 m in areas of midtown.

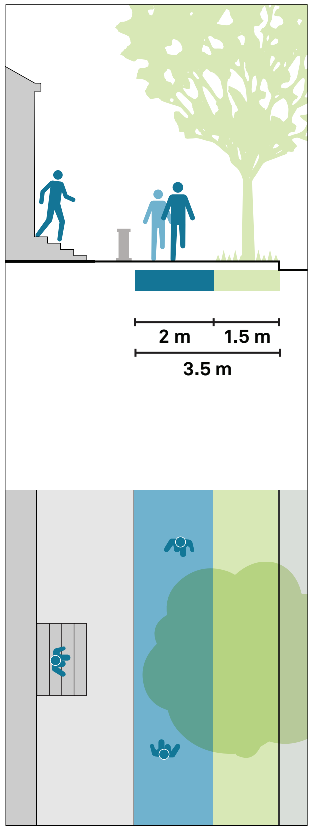
Broadway; New York City, USA

Geometry



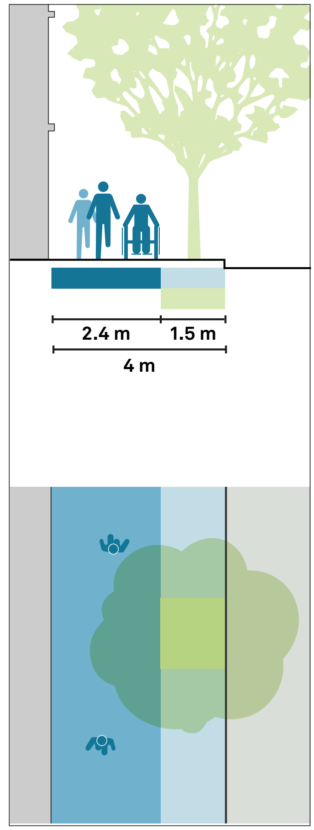
Narrow Sidewalk

Quiet streets in low-density contexts might have too narrow sidewalks. A recommended minimum clear path of **2.4 m** and an absolute minimum of **1.8 m** should be provided. When streets are too narrow for trees, other alternatives to landscaping should be explored. If comfortable sidewalks cannot be provided on both sides of a street, a shared street is preferred. Locate utilities and other obstructions immediately against the curb.



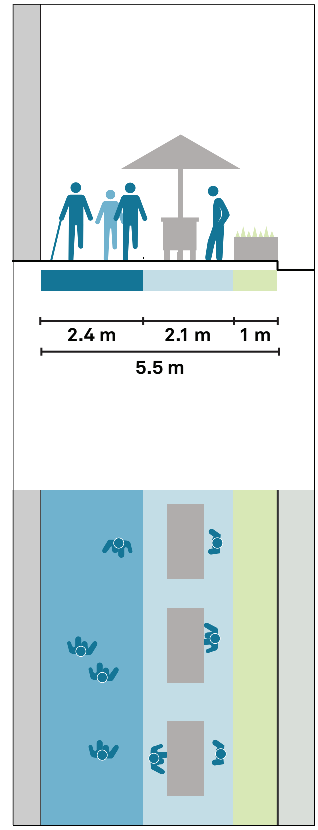
Ribbon Sidewalk

In low-density streets where the sidewalk sits between a planting strip and a set-back building, provide a minimum width of **2 m**. Tree pits should not be less than **1.5 m** wide. Locate utility poles in the planting strip.



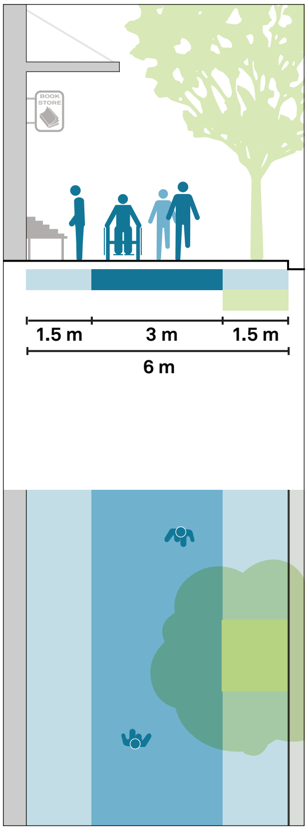
Narrow Sidewalk with Trees

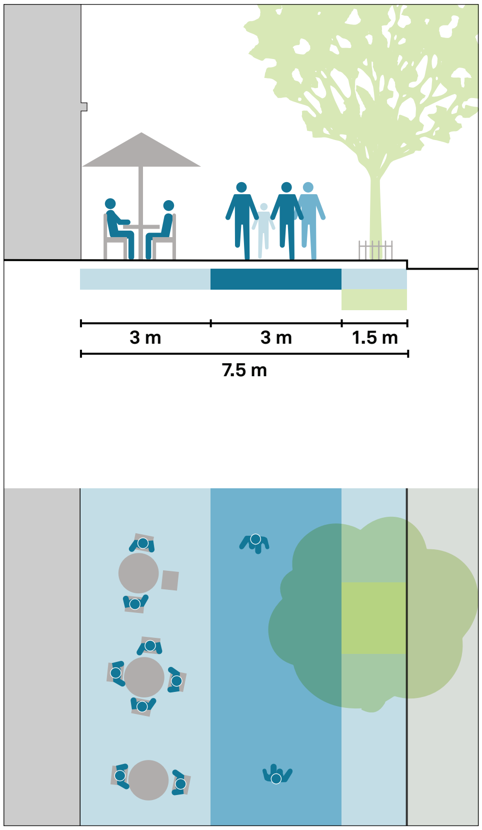
Medium-density residential streets should maintain a clear walking path of **2.4 m** or more. When space allows, trees should be planted between the clear path and the moving or parking lane. Tree pits should be at least **1.5 m** wide.

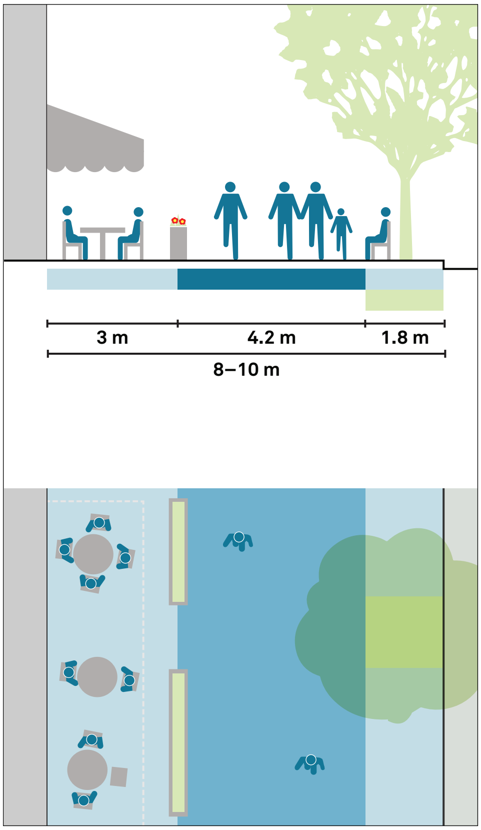


Neighborhood Main Street 1

On small retail streets with low but persistent pedestrian traffic, sidewalks should provide a minimum clear path of **2.4 m** in addition to space for commercial activities. When there is not enough width to plant trees, provide landscaping strips or planters.







Neighborhood Main Street 2

Neighborhood main streets should provide a clear path of **2.4 m** to allow moderate volumes of people to comfortably pass one another. Space for commercial activity to extend from storefronts should be allocated on the building side. Tree pits, planters, and seating should provide a buffer between pedestrians and moving vehicles or cycles.

Medium Commercial Sidewalk

Commercial corridors should provide a clear path of **3 m** or more to allow a continuous flow and enable people to comfortably pass one another. Ground-floor activities from adjacent buildings can be encouraged to activate the sidewalk by providing flexible and dedicated space on the sidewalk adjacent to the clear path.

Wide Commercial Sidewalk

Busy commercial corridors with heavy pedestrian flows and activities should be designed, when possible, with a width of **8–10 m**, allowing for commercial activity, street furniture, transit stops and shelters or queuing spaces, landscaping, and green infrastructure.

Design Guidance

Sidewalks are a fundamental form of urban infrastructure that facilitate walking, socializing, interacting, and doing business. They must be provided on all urban streets and be accessible to all users.

Dimensions

Sidewalk design should go beyond the minimum in both width and amenities. Pedestrians and businesses thrive where sidewalks are designed at an appropriate scale, with sufficient lighting, shade, and street-level activity.

These considerations are extremely important for streets with high traffic volumes, where pedestrians may avoid the area because they feel unsafe.

Sidewalks should be delineated by a vertical or horizontal separation from moving traffic to provide adequate buffer space and a sense of safety for pedestrians. Do not use shoulders or stopping lanes as a substitute for sidewalks.

Clear Path

Provide sufficient width, **1.8–2 m**, so two people using wheelchairs can comfortably pass each other.

Clear paths must be free of fixed objects and major gaps or deformities that would make them inaccessible.

At driveways, clear paths should be continuous and step-free through the conflict zone.

If existing trees obstruct the clear paths for pedestrian movement, extend the sidewalk beyond the tree line to create additional space.

Do not place transit shelters directly within the path of travel. When the space is not sufficient, install a transit bulb or a boarding island.

Building Edges and Facades

Facades and storefronts should be designed to respond to the pedestrian's eye level, with a focus on how each building meets the sidewalk. The lower 5 m of a building is the portion directly visible and most intensely experienced by the pedestrian.[1]

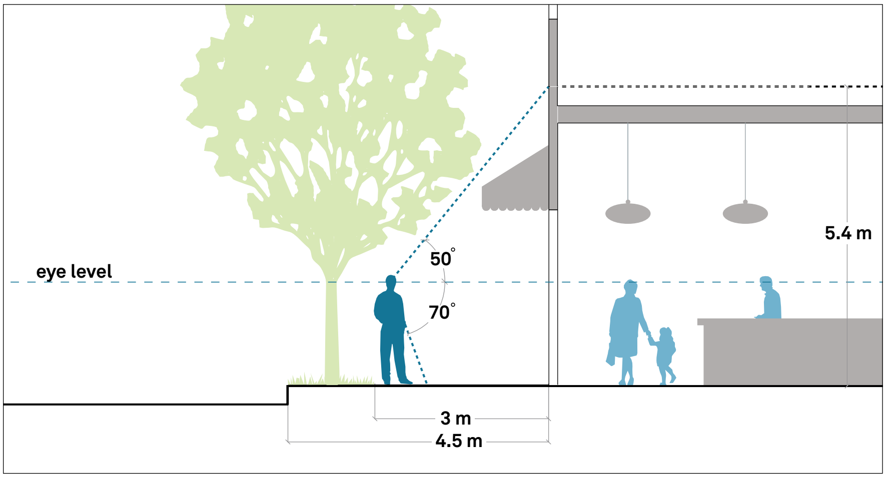
Provide or encourage lighting, signage, awnings, and other elements that are scaled to the pedestrian realm and add to the texture of the street.

Provide frequent building entrances to foster active spaces.

Provide an open or glazed frontage that engages pedestrians, encourages pausing, provides passive surveillance, and links public and private space.

Sidewalk cafés foster street life and have the potential to increase business along a corridor. Where provided, these must maintain accessible clear paths.

Urban arterials or high-volume downtown streets directly abutting the pedestrian realm should be buffered in some manner. Planting, street furniture, and, occasionally, vehicle parking or loading bays can provide a valuable buffer between the pedestrian and vehicle realm.



Human field of vision is geared toward looking ahead and downward. When walking, the head is generally inclined 10 degrees down and sees 50 degrees above and 70 degrees below eye level. This places great importance on the design of the ground floor of buildings adjacent to the sidewalk.

Utilities

Realign utilities such as lighting poles, service boxes, telephone booths, gas valves, water fountains, and manholes so that a clear walking path is free of obstructions. Where this is not possible, widen sidewalks to provide additional pedestrian space.

Coordinate with relevant agencies and utility companies to ensure street designs accommodate space for new utilities without impeding accessibility. Utilities with surface components should align with the finished road and sidewalk elevations to avoid tripping hazards or risk of injury.

Trees and Landscaping

Include trees and planting to provide shade and a sense of enclosure to the street. Plant native species to enhance biodiversity. Preference tree species whose roots have a limited impact on the integrity of the sidewalk.

When streets are redesigned, existing trees should be retained where possible. If existing trees must be removed, the same number of trees should be planted within the street.

Construction Sites

Any construction project that obstructs the sidewalk should be mitigated by providing a temporary sidewalk with a safe and convenient passage or a clearly marked detour. Provide adequate lighting beneath scaffolding and other construction sites.

RESHAPING SIDEWALKS; CHENNAI, INDIA

Before

After

Chennai, India

In 2013, the Institute for Transportation and Development Policy (ITDP) released *Footpath Design: A Guide to Create Footpaths*, providing basic guidance for sidewalk design in the Indian context. Sites that previously had narrow footpaths, high curbs, and were blocked by obstacles have been redesigned and reconstructed to provide a safe place for pedestrians to walk out of the roadbed.

Accessible sidewalks should be provided on both sides of all streets in urban areas.[2]

6.3.5 | Pedestrian Crossings

Safe and frequent pedestrian crossings support a walkable environment. Pedestrians are especially sensitive to minor shifts in grade and geometry, detours, and the quality of sidewalk materials and lighting. Pedestrian crossing design has the potential to shape pedestrian behavior, while guiding people toward the safest possible route.

São Paulo, Brazil. A colorful pedestrian scramble in the city center.

Design Guidance

Location

Pedestrian crossings can be located at an intersection or mid-block.

Provide pedestrian crossings at all legs of intersections. Pedestrians are unlikely to comply with a three-stage crossing and may place themselves in a dangerous situation as a result.

Install a pedestrian crossing where there is a significant pedestrian desire line. Frequent applications include mid-block bus stops, metro stations, parks, plazas, monuments, or public building entrances.

Spacing

Provide level crossings every **80–100 m** in urban environments.[3] Distances over **200 m** should be avoided, as they create compliance and safety issues.

If it takes a person more than three minutes to walk to a pedestrian crossing, he or she may decide to cross along a more direct, but unsafe route.

Pedestrian crossing spacing criteria should be determined according to the pedestrian network, built environment, and desire lines. Designers should take into account both existing and projected crossing demand.

Marking

Always mark the pedestrian crossing, regardless of the paving pattern or material.

High-visibility ladder and zebra markings are preferable to parallel or dashed pavement markings. These are more visible to approaching vehicles and have been shown to improve yielding behavior by drivers.

Signalization

Where vehicle speeds are above 30 km/h and pedestrian volumes and crossing demands are moderate to high, provide signalized crossings to support a safe walking environment.

Uncontrolled crossings are generally safe on streets with low traffic volumes, and speeds below 30 km/h.

Length (Crossing Distance)

Keep crossing distances as short as possible using tight corner radii, curb extensions, pedestrian refuge islands, and medians.

Medians and refuge islands create a two-stage crossing for pedestrians, which is easier and safer when crossing multiple lanes of traffic.

Width

A pedestrian crossing should be at least as wide as the sidewalks it connects to and not be less than **3 m** wide.

Visibility and Daylighting

Provide adequate waiting areas for pedestrians to see oncoming traffic and increase visibility for drivers by adding curb extensions or refuge islands.

Restrict parking or install curb extensions in order to make pedestrians more visible to motorists and cars more visible to pedestrians. This is called *street daylighting* and must be provided at all crossings.

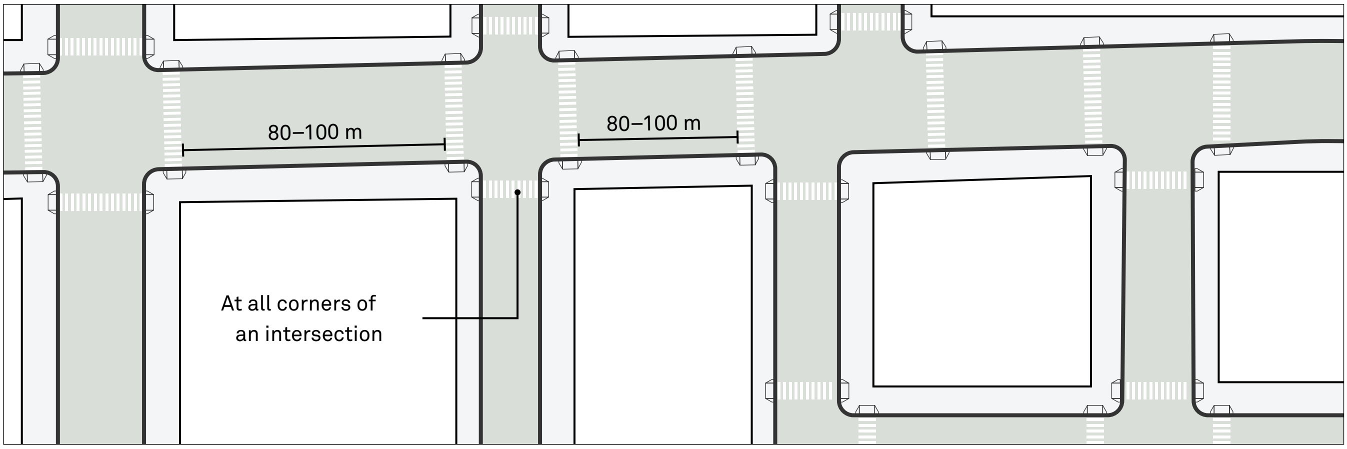
Additional Safety Measures

The presence of a pedestrian crossing does not alone render a street safe. Based on pedestrian and traffic volumes, speed, and roadway width and configuration, pedestrian crossings may require additional safety measures such as refuge islands, signals, or traffic calming strategies.

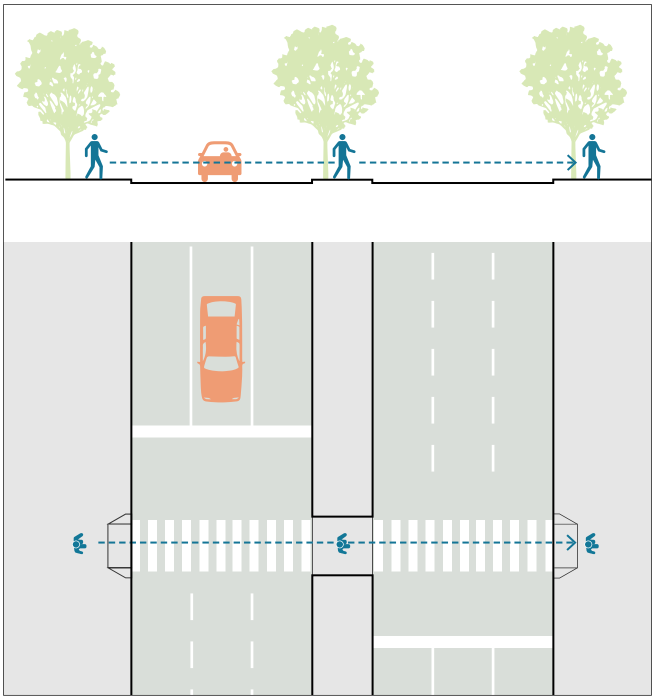
Grade Separation

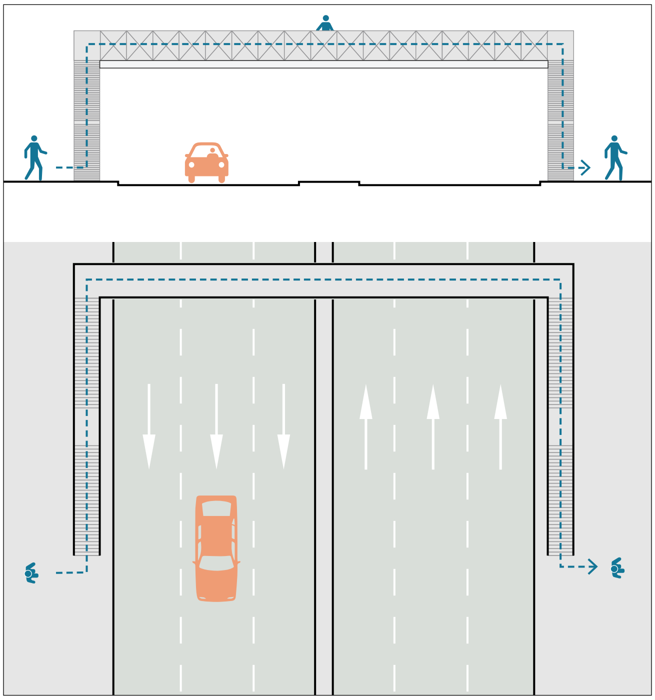
Always provide pedestrian crossings at grade, except in instances where they cross limited-access highways or natural feature such as rivers.

Pedestrian overpasses and underpasses take up sidewalk space, dramatically increase walking distance, and are frequently avoided by pedestrians in favor of a more direct crossing. They are very expensive and need regular maintenance to keep them clean and safe. In many cases, they are underutilized and poorly maintained. By removing pedestrians from the natural surveillance of the street, they raise personal safety issues.



Pedestrian Crossing Spacing: Safe, accessible crossings should be provided every 80–100 m, and at all legs of an intersection, to ensure a connected walkable network.

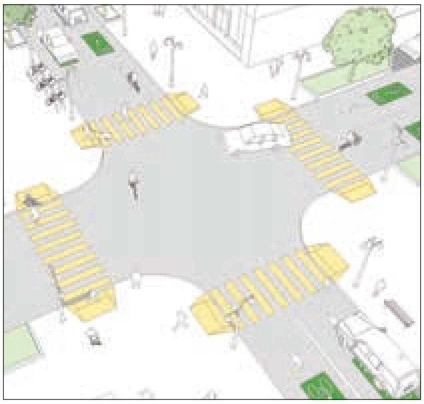




At-Grade Pedestrian Crossings: Unless connections are required across limited access highways, heavy rail lines, or natural features, pedestrian crossings should be provided at the same level as the street. Elevated crossings unnecessarily increase walking distances and times, take up valuable sidewalk space, and cost up to 20 times the price of at-grade signalized crossings.

Provide level crossings every 80–100 m at minimum. If it takes a person more than three minutes to walk to a pedestrian crossing, he or she may decide to cross along a more direct, but unsafe or unprotected, route.

Crossing Types



Pedestrian Volumes	Low to High
Signalized	Yes
At Intersection	Yes
Mid-Block	No
Vehicular Speed	Any Speed
Vehicular Volumes	Low to High

Conventional Crossing

Pedestrian crossings should be aligned as closely as possible with the pedestrian clear path. Inconvenient deviations create an unfriendly pedestrian environment.

Many pedestrian crossings are designed using inadequate, narrow striping, setbacks from intersections, and deviations from the pedestrian clear path, resulting in considerable crossing distances.

Intersection crossings should be kept as compact as possible, facilitating eye contact by moving pedestrians directly into the driver's field of vision.

Pedestrian Volumes	High
Signalized	Yes
At Intersection	Yes
Mid-Block	No
Vehicular Speed	Any Speed
Vehicular Volumes	Medium to High

Diagonal Crossings

A diagonal crossing, also called pedestrian scramble, is a type of crossing in which a dedicated phase allows pedestrians to cross the intersection in every direction at the same time. During this phase all vehicular traffic is stopped.

This type of signalized crossing avoids conflicts between pedestrians and turning vehicles.

It should be applied only at intersections with high pedestrian volume and should be designed to provide enough space for large numbers of people to gather on the sidewalk corners.

If not well-coordinated, it can create long waiting times for both pedestrians and motorists. Reduce waiting time for pedestrians for higher compliance and increased safety.

Pedestrian Volumes	Medium to High
Signalized	No
At Intersection	Yes
Mid-Block	Yes
Vehicular Speed	Below 30 km/h
Vehicular Volumes	Medium to High

Raised Crossings

Non-signalized crossings at intersections and mid-block can be raised, extending the level of the sidewalk across the street.

This helps calm traffic, improve accessibility, and increase visibility between motorists and pedestrians.

Raised crossings can be applied in busy neighborhood main streets and commercial streets, or where small neighborhood streets with slower speeds meet larger corridors. *See 11.5 and 11.6: Small Raised Intersection and Neighborhood Gateway Intersection.*

Pedestrian Volumes	Low to Medium
Signalized	No/Actuated
At Intersection	No (prefer raised)
Mid-Block	Yes
Vehicular Speed	Above 30 km/h
Vehicular Volumes	Medium

Traffic Calmed Crossings

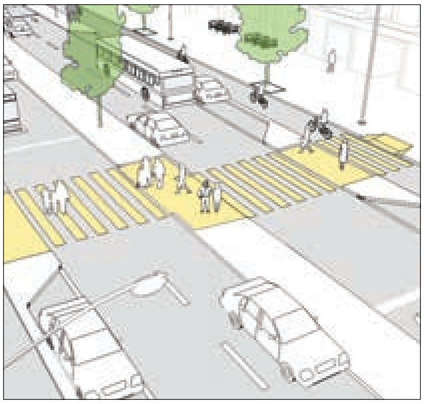
At mid-block crossings where motorist compliance is low, use vertical deflection measures such as speed bumps, tables, and cushions to reduce motorist speed and warn them of the presence of an upcoming pedestrian crossing.

Vertical speed control elements should be set back **5–10 m** from the crossing according to vehicular speed. A series of bumps before the crossing increases compliance levels.

Use pedestrian-activated warning lights, flashing beacons, or High Intensity Activated Crosswalks (HAWK) to increase motorists' awareness and improve pedestrian safety.

The pedestrian crossing could also be raised to increase mutual visibility between pedestrians and motorists.

In streets with high vehicular volumes, give preference to conventional crossings with fixed signalization.



Pedestrian Volumes	Low to Medium
Signalized	Actuated
At Intersection	No
Mid-Block	Yes
Vehicular Speed	Above 30 km/h
Vehicular Volumes	Medium

Staggered Crossings

Staggered crossing should only be applied when the depth of the cut-through allows full accessibility. They allow pedestrians to face the direction of oncoming vehicles, increasing visibility along the crosswalk.

The minimum width of the median should be **3 m** and the offset between the two legs of the pedestrian crossing should not exceed **1 m**, keeping crossing distances to a minimum.

The stop bars at this type of mid-block crossing should be set back **5–10 m**.

If vehicular volumes are high or compliance levels are low, other strategies, such as calming the crossing using speed bumps, tables, cushions, or implementing fixed signalization should be employed.

Pedestrian Volumes	Low
Signalized	No
At Intersection	No
Mid-Block	Yes
Vehicular Speed	Below 30 km/h
Vehicular Volumes	Low

Pinchpoint/Yield Crossings

Crossing design in conjunction with pinchpoints, provides short crossing distance at mid-blocks.

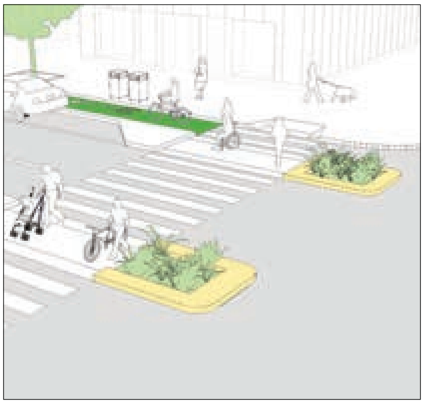
By reducing the roadway from two lanes to one lane at a mid-block, drivers are forced to reduce speed and yield to traffic coming from the opposite direction.

Maintain a lane width of **3.5 m** at the pinchpoint for emergency vehicle access.

6.3.6 | Pedestrian Refuges

Medians or refuge islands create a two-stage crossing for pedestrians, making it easier and safer to cross multiple lanes of traffic.

They should be installed in all streets where pedestrians have to cross three or more lanes or in narrower streets where speeds and vehicular volumes make single-stage crossings prohibitive or unsafe.



Pedestrian Refuge Islands

Pedestrian refuge islands should be at least **1.8 m** deep but have a preferred depth of **2.4 m**.

The width of the cut-through should equal the width of the pedestrian crossing or be at least as wide as the clear path. When the cut-through is wider than **3 m**, install bollards to impede vehicles from parking or manoeuvring in the pedestrian refuge.

A pedestrian refuge island is ideally **10–12 m** long, providing enough protection at each end of the waiting space. Longer islands can be used to deter motorists from using the space for U-turns.

Pedestrian refuge islands should be clearly visible to drivers, be well lit, and provide reflectors for improved nighttime visibility.

Pedestrian refuge islands should include curbs, bollards, or other features to protect people waiting to cross.

Median Tips

All pedestrian refuges at intersections should have a tip or nose that extends past the pedestrian crossing.

This protects people waiting on the median from moving vehicles and slows turning motorists.

To further reduce crossing distance, provide curb extensions at intersections where curbside parking is available.

Align median tips with sidewalk edges to reduce the speed of turning vehicles and maintain pedestrian crossing aligned with the clear path.

Median Cut-Throughs

Cut through raised medians to provide level crossing. Cut-throughs should be provided where there is a significant pedestrian desire line, in front of transit stops and key destinations, or when the distance to the closest safe pedestrian crossing is more than **80–100 m**.

For streets with more than one lane per direction or speeds above **30 km/h**, crossings should be signalized or traffic calmed.

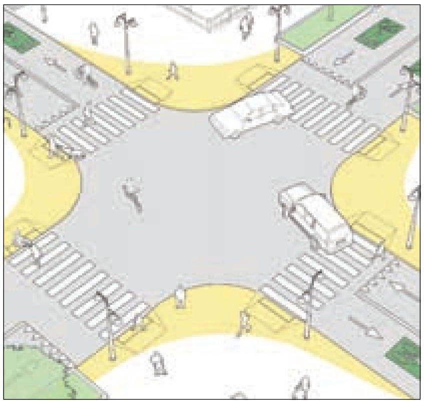
If not signalized, the crossing should be raised or traffic calmed.

Medians should be at least **1.8 m** deep but have a preferred depth of **2.4 m**.

The width of the cut-through should be equal to the width of the pedestrian crossing, or at least as wide as the clear path.

6.3.7 | Sidewalk Extensions

Providing sidewalk extensions reduces pedestrian crossing distances and increases the pedestrian space. Sidewalk extensions physically and visually narrow the roadway while increasing the available waiting space and provide areas for street furniture and benches, transit stops, trees, and landscaping. They may be implemented throughout the city, may be different sizes, and may combine stormwater management and other public space enhancement.

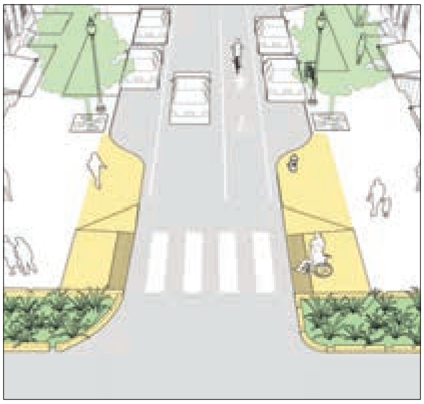


Corner Alignments

Corner alignment extends the sidewalk by designing sidewalk corners with the tightest radius possible. Corner alignments increase mutual visibility between pedestrians and motorists, increase waiting space, and reduce the crossing distance.

These can be generally applied using temporary pavement materials and be implemented without operational changes. Sidewalk corners with wide corner radii invite vehicles to turn at faster speeds and increase pedestrian exposure.

Aligning sidewalks expand the pedestrian area, allowing a more direct walking path and a better pedestrian ramp alignment, thereby improving accessibility.



Bulb-Outs

Bulb-outs are extensions of the sidewalk into the parking lane. They should be installed whenever on-street parking is present to increase visibility, reduce the crossing distance, provide extra waiting space, and allow for seating or landscaping.

In advance of a full reconstruction, gateways can be designed using striping or signage that communicates the entrance to a slow zone.

The length of a bulb-out should at least be equal to the width of the pedestrian crossing, but should preferably extend to the stop bar.

Bulb-outs are often used as traffic calming measures and are referred to as **pinchpoints** when applied mid-block, **gateways** when installed at the entrance to a low-speed street, and **chicanes** when used to form an S-shaped path of travel to lower vehicle speed. *See 6.6.7: Traffic Calming Strategies.*

When used to align a bus stop with the parking lane, bulb-outs are called bus bulbs. *See 6.5 Designing for Transit Riders.*

Slip Lane Removal

Slip lane removal extends the sidewalk to include the travel lane and the traffic island. Slip lanes are sometimes provided at intersections of major urban roads to facilitate vehicle turn to the detriment of pedestrian safety. Slip lanes allow vehicles to turn at higher speeds and reduce motorist and pedestrian visibility, creating potentially unsafe conditions for pedestrians.

Removing slip lanes does not necessarily involve operational changes but can drastically reduce the risk of right-turn collision between vehicles and pedestrians attempting to cross.

Slip-lane removals reduce pedestrian exposure and increase the available pedestrian space, making room for street furniture and landscaping.

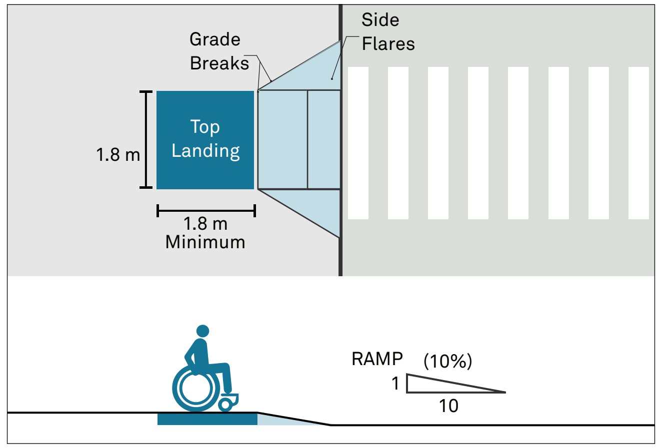
6.3.8 | Universal Accessibility

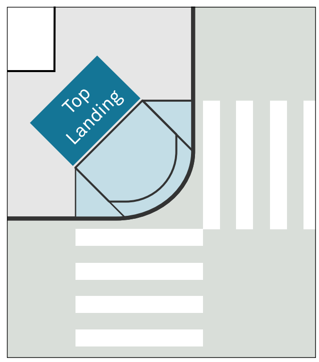
Pedestrian Ramps

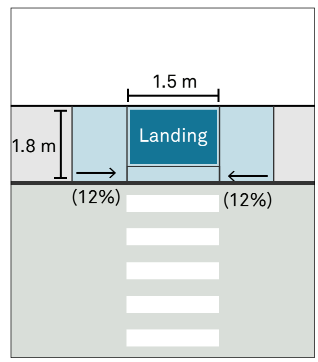
Pedestrian ramps are inclined planes facilitating the access of sidewalks for people using wheelchairs and other personal mobility devices, as well as those pushing strollers, carts, or heavy luggage. They are generally composed of three elements: the slope, the top landing, and the side flares.

- **Slope**
  The slope should be constructed of non-slip materials and be of a maximum slope of **1:10 (10%)**—ideally **1:12 (8%)**. The ramp width should be as wide as the clear path: minimum **1.8 m** wide, **2.4 m** recommended.
- **Top Landing**
  The top landing is located at the top of the ramp and allows ramp access across side flares. The landing should be as wide as the clear path or minimum **1.8 m** wide.
- **Side Flares**
  Side flares are intended to prevent tripping hazards. Side flare slopes cannot exceed **1:10**. Grade breaks at the top and the bottom must be perpendicular to the direction of the ramp.

Pedestrian ramps can be oriented parallel to sidewalks, where space is limited and it is difficult to fit a top landing.
A level landing of a minimum **1.8 m** length accommodates the maneuvering of a wheelchair.



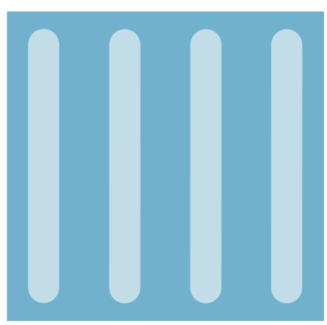


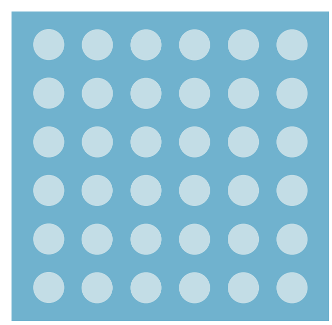


Detectable Surfaces

Provide tactile paving or detectable warning strips at curb ramps and other transitions between pedestrian, vehicular, or shared areas.

Detectable surfaces should provide a distinctive texture intended to have a uniform meaning in alerting people to the approach of conflict zones.


Block indicates “go”

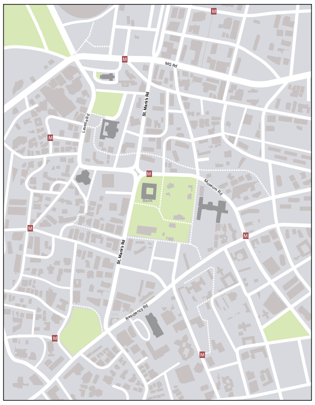

Block indicates “stop”

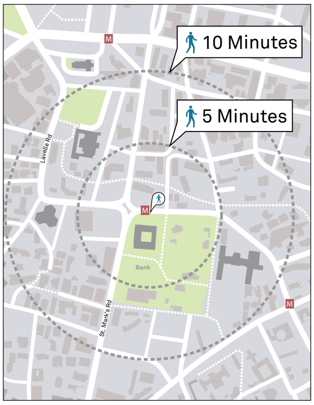
6.3.9 | Wayfinding

Wayfinding

Wayfinding systems should encourage walking and transit usage by providing multimodal information and adopting the pedestrian perspective. Wayfinding works with other visual cues to help people orient themselves and provide confidence in navigating the geography of a city. Wayfinding can increase people's comfort in choosing to walk when they understand a destination proximity.

Quality wayfinding systems should indicate walking and cycling time with **5- and 10-minute** walking distances.





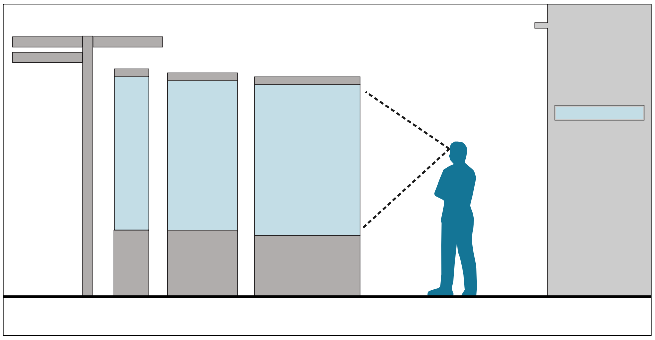
Location

Locate wayfinding elements near key destinations with high pedestrian volumes, such as transit stops, parks, public facilities, and markets.

Size

Scale wayfinding elements to the human body, eye, and height, including adults, children, and people using wheelchairs. Font type and size should be simple and big enough to be read by people with low vision or who are visually impaired. Maps and signs should include braille characters, especially at key destinations and areas with high pedestrian volumes.

Use clear visual language, graphic standards, and maps that can be universally understood. Inclusive signage and wayfinding should inform all type of users, from residents and workers to visitors and tourists.



LEGIBLE LONDON; LONDON, UNITED KINGDOM

Legible London is a wayfinding system designed and implemented to help pedestrians find their way around London. The maps display journey times by showing 15-minute and 5-minute walking circles and uses heads-up maps oriented in the direction the user is facing.
At stations, signage is integrated with station signs to minimize street furniture clutter. Transport for London (TFL) is prototyping the integration of touch-screen digital technology to include interactive maps and other real-time information services.

The program works with boroughs, Business Improvement Districts, and other organizations to expand the program further. TFL worked with a range of organizations representing disability groups to ensure that the Legible London design is inclusive, providing the number of steps, pavement widths, and pedestrian crossings.

Launched in 2006, Legible London currently has 1,300 signs. Research shows that nine out of ten people were keen to stop and read for directions.

London, United Kingdom

6.4 | Designing for Cyclists

6.4.1 | Overview

Encouraging cycling as an efficient and attractive mode of transportation requires the provision of safe and continuous facilities. Cycling is a healthy, affordable, equitable, and sustainable mode of transportation, with positive impacts on congestion and road safety. Cities that invested in cycling have seen congestion levels decline and streets become safer for all users.[4]

Cycling is also good for the economy. Many recent studies demonstrate the impact of cycling on local economies. Cities that increase the cycle accessibility of their business centers attract new customers, generating more spending in local stores, and ultimately creating jobs and tax revenues. Infrastructure and design can make cycling a popular activity, appealing to a wide range of potential riders.

While cyclists can share the road with motor vehicles on quiet streets with low speeds, navigating larger streets and intersections requires dedicated facilities. Design safe and comprehensive cycle networks for cyclists of all ages and abilities. If cycling is not a safe option, potential cyclists may decide not to ride.

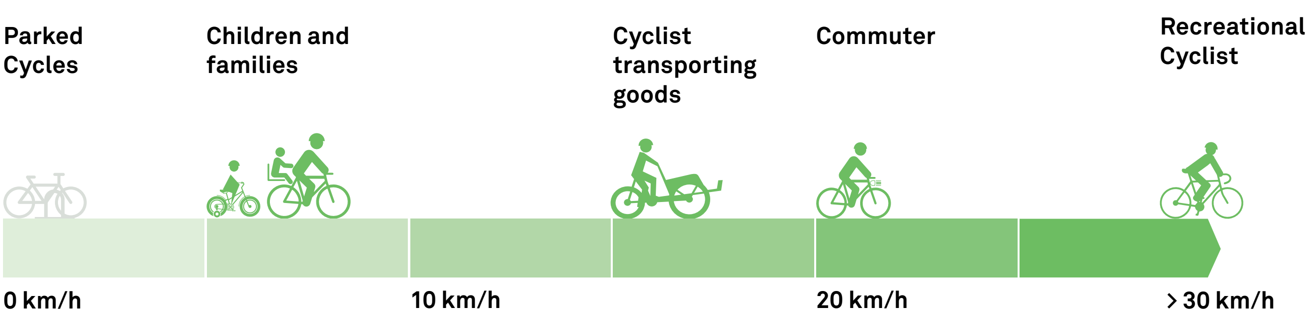
High-volume corridors should provide wider cycle facilities to carry larger volumes. Creating a bikeable city requires secure cycle parking spaces, easy access to transit, and a cycle share system.

Cycle lanes and tracks should allow for social and conversational riding for everyday use as well as long commutes. They should be designed for all types of riders and all levels of comfort, from the 5-year-old to the 95-year-old cyclist.

Speed

Cyclists ride at different speeds depending on their purpose, the length of their total route, their confidence level, and the facility they are using. Young children will ride at a slower speed than a cyclist making a delivery, and visitors will ride differently from locals and commuters. Design cycle facilities to accommodate riders at various speeds. Provide sufficient protection from travel lanes, taking into account speed differentials and vehicle volume.

Electric cycles that travel up to 20 km/h often share facilities with other cycles. Design wider cycle lanes along high-volume corridors to allow fast riders to pass slower riders.

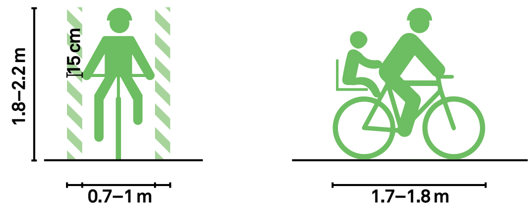


Variations

Cycle facilities should be designed for diverse vehicles and riders, for children on small tricycles, and people carrying goods in big cargo bikes, as well as cycle-rickshaws and pedicabs.

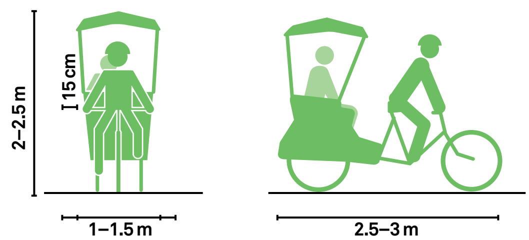
Conventional Bicycles

The most common non-motorized, single-track vehicle.



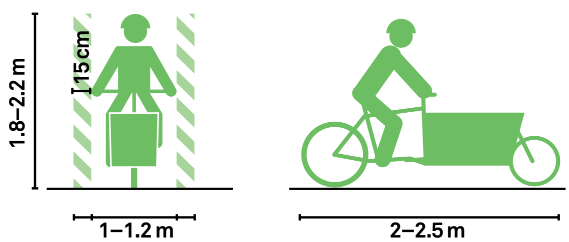
Tricycles, Cycle-Rickshaws, and Pedicabs

Tricycles such as pedicabs and cycle-rickshaws are wider, and in some cases share cycle lane facilities. They typically carry one to two passengers.



Cargo Bikes and Cycle Trucks

Cargo bikes are human-powered vehicles specifically designed for transporting loads. A cargo bike may have different forms and dimensions and can be either a bicycle or a tricycle.



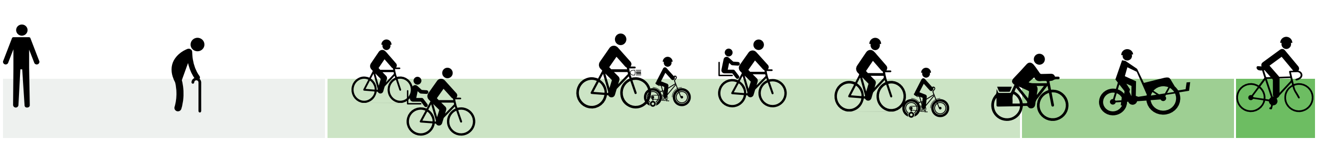
Electric Cycles or E-bikes

These are cycles with electric engines.

Levels of Comfort

Many people are interested in cycling but are dissuaded by stressful interactions with motor vehicles. These potential cyclists, defined as "interested but concerned," account for a majority of the population and vary by age and cycling ability.[5] Experienced and casual cyclists are more traffic tolerant, but they account for a significantly smaller share of the population.

Cycle facilities should be designed not only for the highly capable and experienced cyclist, but also and especially for young children learning to ride, for senior riders, adults carrying children or freight, and workers commuting long distances. These riders need higher degrees of separation and protection from motor vehicle traffic.



6.4.2 | Cycle Networks

In order to promote cycling as a viable transportation option, a comprehensive network of cycle facilities must be planned and designed. A hierarchy of routes should be based on the existing urban street network and key destinations. Integrate cycle networks with transit systems and pedestrian priority areas. The design of cycle networks should consider safety, capacity, and connectivity for all riders. Design for future capacity and mode share goals rather than present-day demands.

Safety

Safety
Cities should design and implement cycle facilities that provide safe routes for cycling for all ages and abilities. Facilities should be well maintained and kept clear of debris and obstacles.

Sightlines
Ensure that facilities provide clear sightlines for the person on a cycle to clearly see pedestrians and motorists as well as parked cars.

Comfort

Comfort and Quality
Provide low-stress facilities for less confident riders. The quality of the facility, the amount of space to ride, and the buffer between moving vehicles will all impact a route's usability and safety. The smoothness of the surface, the clear drainage of water, and added landscaping will all contribute to a quality ride. Trees can add protection and shade in hot climates.

Signage and Communication
Provide clear wayfinding for cycles and signage for drivers to increase awareness among users. Indicate distances, directions, priorities, and zones shared with other users through ground markings and signage. Map the city's cycle network and show route types. Tie cycle network developments with media campaigns and public events such as open streets or ride-to-work/school programs and promote cycle facilities. Signage and communication allow cyclists to better navigate the city and increase overall mode share.

Connectivity

Connected and Continuous
Cycle routes should allow cyclists to reach their destinations. While the types of lanes may vary along the way, ensuring that cycle facilities are continuous is critical to promoting cycling as an attractive and sustainable mode of transportation.

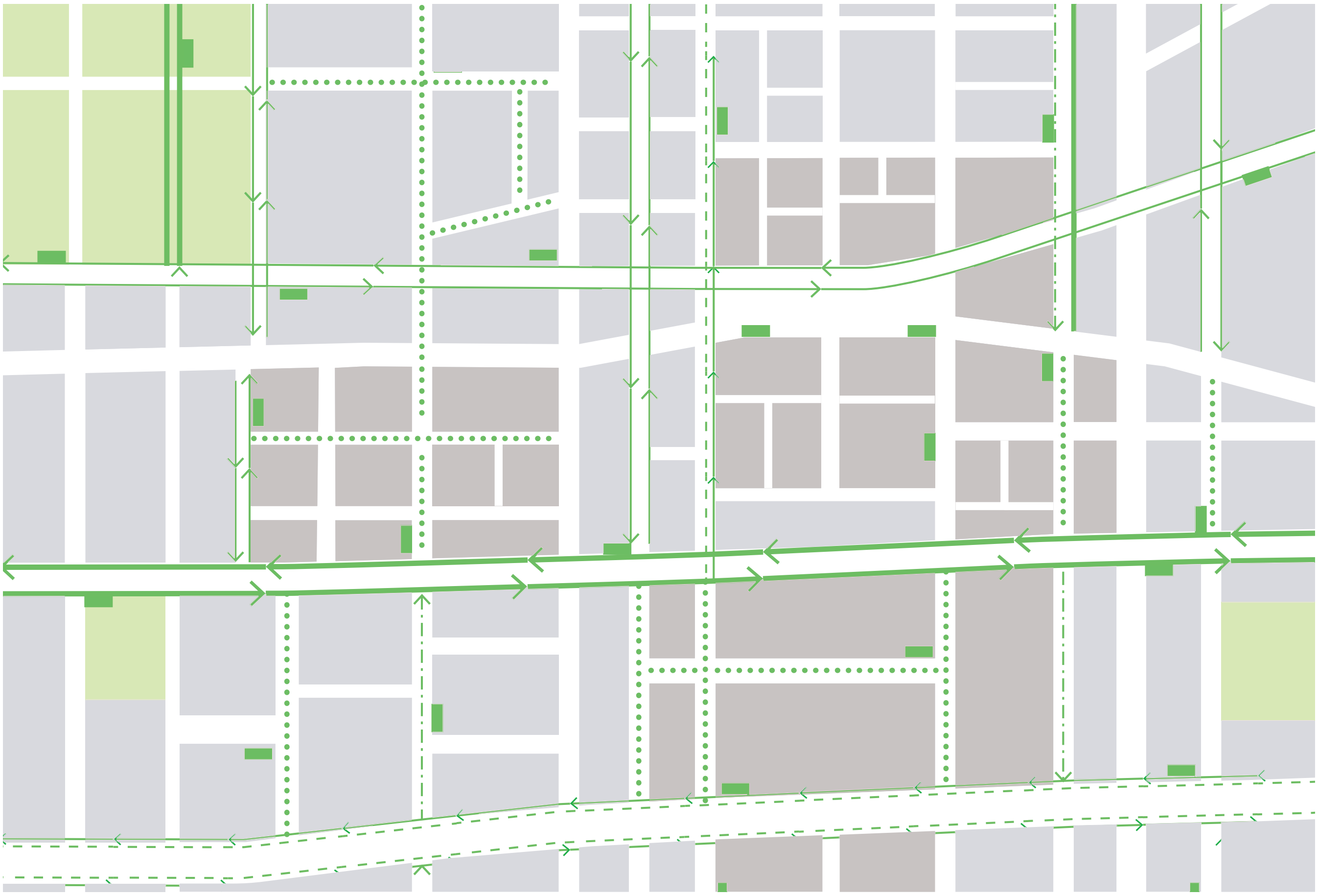
Comprehensive
Ensure that the network covers all neighborhoods and offers equitable access to cycle facilities and infrastructure. Destinations such as transit stations, schools, parks, markets, community centers, factories, and office areas should be connected directly when planning cycle networks.

Direct
A cycle network must get riders where they are going in a direct and convenient fashion, avoiding circuitous routes where possible. In cases where steep inclines or hills exist, less direct routes might be preferable if the total path is flatter. Contraflow cycle streets can improve permeability and access for riders when adopted as a citywide approach and supported by increased awareness by motorists.

THE WIGGLE, CYCLE FLAT ROUTE SAN FRANCISCO, UNITED STATES

The Wiggle is the local name given to a portion of San Francisco's cycle network—a relatively flat route between downtown San Francisco and Golden Gate Park, enabling cyclists to avoid some of San Francisco's steep hills. The Wiggle inclines, on average, at 3% and does not exceed 6%, connecting various street blocks in a zig-zag pattern.

Cyclists can now travel the Wiggle between major eastern and central neighborhoods, and major western neighborhoods on connected cycle facilities.



Cycle Networks: Cities should prioritize cycling as a sustainable mode of transportation by ensuring comprehensive cycle networks are planned and implemented. Offering a range of cycle facilities that provide safe, convenient, and connected routes will help cyclists to reach key destinations without the need for motorized travel. Complement cycle networks with cycle parking spaces, clear wayfinding, cycle share programs, and connections to collective transport infrastructure.

- Cycle street
- Cycle lane
- Contraflow cycle lane
- Buffered cycle track
- One-way cycle lane
- Two-way cycle track
- Cycle share station

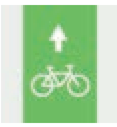
Sydney, Australia. A protected cycle track also incorporates green infrastructure.

Copenhagen, Denmark. Wide, raised cycle tracks allow for people to ride side-by-side.

Buenos Aires, Argentina. A two-way cycle lane on a one-way street increases connectivity.

6.4.3 | Cyclist Toolbox

Use the following list of elements as a checklist to ensure a comprehensive approach to designing safe and comfortable environments for cyclists.

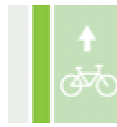


Cycle Facilities

Cycle facilities are spaces specifically designed for the movement of cycles. There are two main types of cycle facilities: dedicated facilities and exclusive facilities. Dedicated facilities are portions of the roadway assigned to the preferential use of cyclists. They are generally called cycle lanes or bike lanes. Exclusive facilities are physically separated from the main carriageway through vertical elements and can solely be used by cyclists.

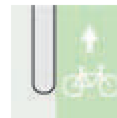
Marked Buffers

At-grade, marked buffers are painted spaces parallel to cycle lanes that separate them from adjacent motor vehicle traffic. They improve comfort and safety for cyclists while discouraging motorists from entering the cycle lane. Buffers should be **1 m** wide and can also be used next to parking lanes to prevent cyclists from being hit by opening car doors.



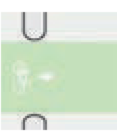
Constructed Buffers

Constructed buffers are barriers built into the roadbed that provide a physical separation to a cycleway. They improve cyclist safety and prevent intrusion by cars and trucks. Planted buffers also present the opportunity for beautification and integration of green infrastructure. The adjoining cycleway should be designed to drain well and be wide enough to allow cyclists to pass each another.



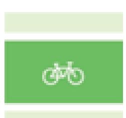
Segmented Concrete Dividers

Segmented concrete dividers create physical separation of a cycle lane to prevent intrusion of cars and trucks while allowing cyclists to exit the cycleway. They are a relatively narrow, easy-to-install way of increasing cyclist safety and comfort. Cycleways with segmented concrete dividers should be wide enough to allow cyclists to pass each other.



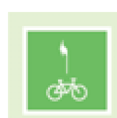
Traffic Diverters

Traffic diverters are street elements that prevent cars from traveling straight, while allowing cycles to do so. They can help maintain low vehicle volumes and reduce vehicle speeds on cycle streets. Some diverter configurations provide opportunities to add vegetation and green infrastructure.



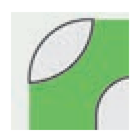
Advanced Stop Bars or Cycle Boxes

Advanced Stop Bars (ASB) provide designated areas ahead of stop lines for vehicles at signalized intersections. They allow cyclists to get ahead of queued vehicles during a red light. They help cyclists make turns across traffic and avoid being hit by vehicles turning across the cycle lane, while reducing cyclist and driver delay. ASB should be at least **3 m** deep, allowing cyclists to maneuver into them and face forward. ASB can be deeper to accommodate higher cycle volumes.



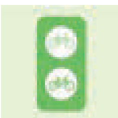
Two-Stage Turn Queue Boxes

Two-stage turn queue boxes are painted waiting spaces that allow cyclists to safely make a turn across oncoming traffic using two signal phases. They are designed to move the cyclist out of the travel path for the first stage of the turn, usually in line with a parking lane, a buffer, or in front of the opposing traffic lane. Once the light changes, the cyclist using the turn queue box can continue in the second direction.



Corner Refuge Islands

Corner refuge islands are concrete barriers at intersection corners with a curved space for cycles between the sidewalk and the roadway. They also provide protected waiting space for cyclists and facilitate two-stage turns. Corner refuge islands, with small turn radii, reduce vehicles speeds and increase cyclist visibility.

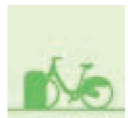


Cycle Signals

Cycle signals are traffic signals designed specifically for cyclists. They can be used at any intersection, especially on high volume streets and cycle streets. Cycle signals improve safety and confidence for cyclists at places with large volumes of vehicular traffic or conflict. Cycle signals—particularly those associated with protected facilities—should be part of the normal signal cycle. If signals are actuated, use automatic detection. Avoid the use of push-button activation in urban settings.

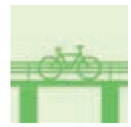
Wayfinding, Signages and Markings

Wayfinding, signage, and markings are elements that identify cycle routes to reach major destinations or connecting cycle facilities. These include signs with directions, specially designed street signs, and markings on the road. When well-designed and comprehensive, they serve cyclists at a level similar to transit wayfinding and highway signs. They increase confidence and signal to drivers that they are on a cycle route and should exercise caution.



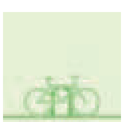
Cycle Share Stations

Cycle share stations are special cycle racks that act as places to pick up or drop off cycle share bicycles. In many cases, these are connected sets of docks with significant physical presence. Cycle share stations can be an integral part of cycle-friendly streets, allowing for spontaneous trips, and serving as traffic calming measures or providing additional protection from motor vehicles. They should be placed near cycle infrastructure and be clearly visible to pedestrians.



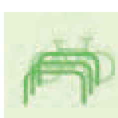
Cycle Bridges and Underpasses

While at-grade facilities for cycles are strongly preferred, sometimes bridges or underpasses can provide direct access for cyclists to cross a waterbody or a rail-road track. They also can improve cycle comfort in climates with extreme temperatures. These should be well-designed, well-lit, and properly maintained to ensure that they are a useful part of the cycle network. Grade changes at bridges should be kept to a minimum. If grade change is substantial, underpasses are preferred for high volume routes since they allow acceleration upon descent.



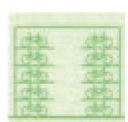
Cycle Racks

Cycle racks are inexpensive street elements that allow cyclists to securely park their cycles. While there are many designs, they are generally made of metal tubing and are bolted to a concrete surface. They are most useful when placed near major destinations or in commercial areas, and should be placed at least **0.75 m** apart. While they create opportunities for unique designs, the functionality and safety of the rack should not be compromised for visual appeal.



Cycle Corrals

A cycle corral is a row of cycle racks placed on the street that occupies space in the parking lane. Existing parking spaces can be used efficiently as cycle parking, which helps free up space on the sidewalks. The cycle racks in the corral should be protected from parked cars by a plastic delineator or parking stops.



Cycle Parking Structures

Cycle parking structures are high-quality cycle parking facilities providing a large amount of cycle parking protected from other street elements. They are installed at transit stations or major destinations such as shopping centers, and often use multilevel cycle racks to maximize storage. These structures should be easily accessible by nearby cycle routes and should be paired with wayfinding and signage that directs cyclists.

6.4.4 | Cycle Facilities

Cycle facilities are designated spaces within the street that are specifically designed for the movement of cyclists. Providing these facilities is fundamental to accommodating cyclists of all ages, abilities, and confidence levels. Cycle facilities in certain contexts may also be designed to provide comfortable cycle lanes for cargo bikes, cycle rickshaws, and other such variations.

Evidence shows that where comprehensive cycle facilities are extensively installed throughout the entire street network, the modal share of cyclists dramatically increases and crashes decrease, making streets safer for all users. A variety of facilities can contribute to the overall network, including cycle lanes, cycle tracks, and cycle streets.

Curb Zone

1 When adjacent to sidewalks or pedestrian spaces, cycle facilities should be physically separated for the comfort of both pedestrians and cyclists.

The sidewalk buffer discourages pedestrians from walking in the dedicated cycle facility and discourages cyclists from riding on the sidewalk.

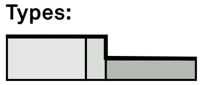
The curb zone can also host important cycle infrastructure elements such as cycle racks, wayfinding maps, and cycle share stations.

Curb

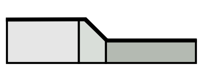
2 If no sidewalk buffer is provided, cycle facilities should be grade separated.

When cycle tracks are raised from the roadbed, a minimum curb reveal of **5 cm** should be provided between the cycle lane and the pedestrian area.

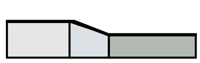
Types:



Vertical



Beveled. Slope Ratio 1:1



Mountable. Slope Ratio 1:4

Cycleway Clear Path

3 The cycle clear path should provide a smooth, continuous cycling path that is free of obstructions. This clear path may vary from **1.8–2 m** for unidirectional paths and may increase in areas of greater demand.

Buffer Zone

4 The buffer zone provides a separation between the cycleway and vehicular traffic or parked cars.

Buffers can be raised or at grade and should be no less than **1 m** wide.

Physically separating the cycle clear path with vertical objects or a raised median maximizes the safety and comfort of people bicycling and driving and should be designed in every street with vehicular speeds more than 30 km/h or with high vehicular traffic.

Facility Types

Cycle Lanes

Also known as conventional bike lanes, these are defined as a portion of the roadway that has been designated by striping, signage, and other pavement markings for the preferential or exclusive use of cyclists. Cycle lanes are typically on the right side of other vehicle lanes in the same direction or left side on one-way streets. Cyclists may have to leave the lane to pass other riders, to make turns, or to avoid obstacles.

MADRID, SPAIN

In an effort to promote cycling in the city, the municipality of Madrid started an ambitious program aiming to double the length of cycle facilities by 2016. In the narrow streets of the center, the Spanish municipality created a network of contraflow cycle lanes in order to increase connectivity and create a safer and more comprehensive cycle network.

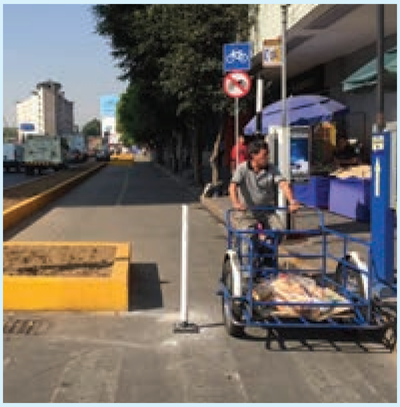
Madrid, Spain. A contraflow cycle lane.

Cycle Tracks

These are exclusive cycle facilities physically separated from motor traffic and distinct from the sidewalks. They provide the highest degree of comfort and safety for cyclists. Streets with cycle tracks have a lower injury rate than comparable streets without dedicated facilities.[6] Protected cycle tracks achieve separation through raised buffers or parking lanes while raised cycle tracks are vertically separated to either meet the sidewalk-level or be a half-a-step between the sidewalk and the street level. Materials, curbs, or bollards help to identify the space and prevent intrusion by motor vehicles.

PUEBLA, MEXICO

In Puebla, Mexico, a 4.7-km cycle track was implemented in 2015, connecting a major university to the city center. Left-side, protected cycle tracks were installed along the medians of Boulevard 14 Sur and two other two-way streets by narrowing the motor vehicle lanes to standard widths. Parking stops, reflectors, and paint demarcate the cycle tracks.



Puebla, Mexico

Cycle Streets

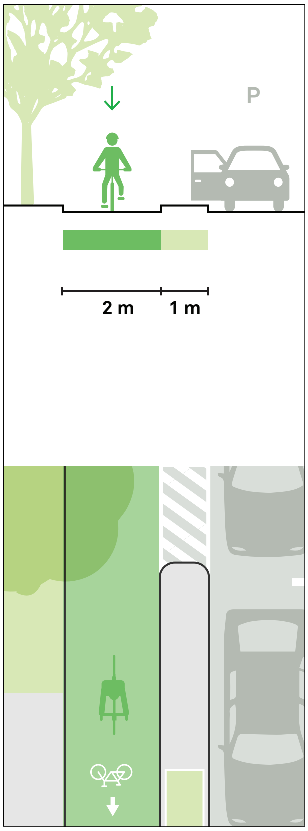
These are streets where cycles share the road space with vehicles, and cars are considered guests. Speeds in these streets should not exceed 30 km/h. Design treatments manage motor vehicle speed and volume by calming or restricting through-traffic, while connectivity remains for cyclists. Cycle streets can play a key role in cycle networks, complementing and providing connections between other cycle facilities.

GOTHENBURG, SWEDEN

This cycle street offers the cyclist a smooth surface for riding in the center of the road, while a car drives on cobblestones lining each side. This design places the cyclists at the center of the street, making them more visible, and requiring drivers to reduce their speed to increase safety.

Gothenburg, Sweden

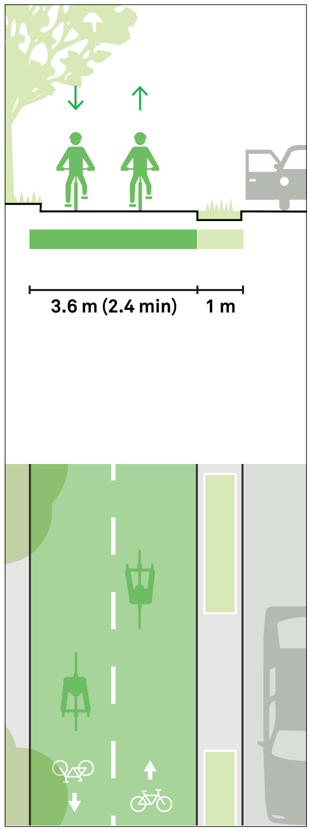
Geometry



Safety ●●●●●
Comfort ●●●●●
Space ●●●●○
Cost ●●●○○

Protected Cycle Track

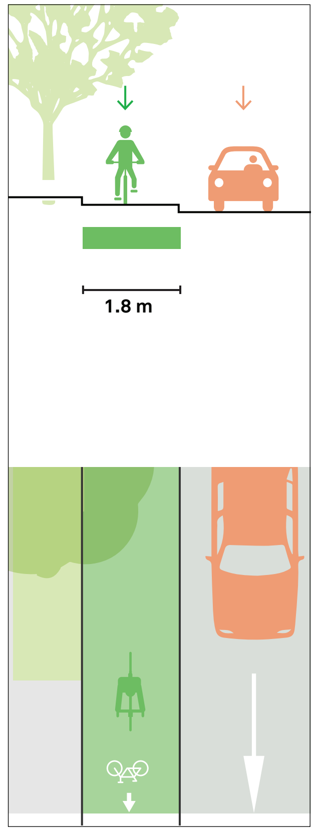
One-way cycle tracks are protected from vehicular traffic by a parking lane or a raised buffer. The track can be at road level, raised fully to sidewalk level, or partially raised with an intermediate mountable curb. Provide **2 m** cycle lanes for cyclists to pass one another and a **1 m** minimum buffer to reduce the risk of conflict with vehicle doors being opened in parking-protected cycle tracks.



Safety ●●●●●
Comfort ●●●●●
Space ●●●●●
Cost ●●●○○

Bidirectional Cycle Tracks

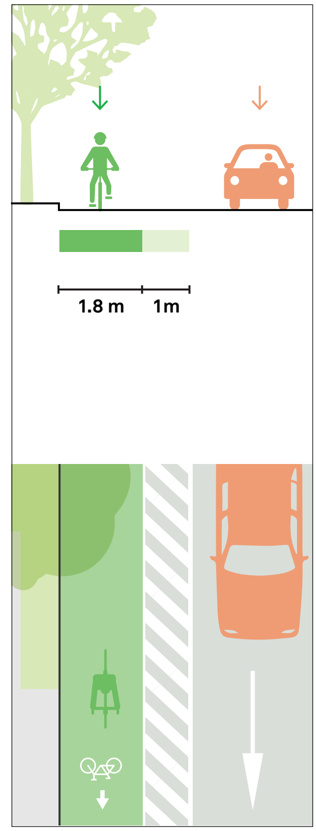
Bidirectional cycle tracks can be located either on the side or in the center of the street. The two cycling directions are separated by a painted dashed line. Two-way cycle tracks are typically assigned to one side of the street, but may be complemented on both sides of wide streets with high cycling volumes or local access needs.



Safety ●●●●○
Comfort ●●●●○
Space ●○○○○
Cost ●●●●○

Raised Cycle Track

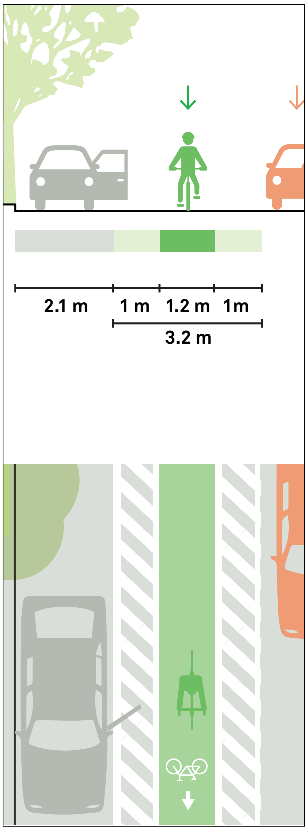
Often called Copenhagen-style cycle tracks, these facilities are vertically separated from motor vehicle traffic, raised either to the sidewalk level or an intermediate level. A mountable curb with a **4:1** slope is provided for safe entry and exit. Protection strategies between cyclists and pedestrians may include street furnishings or low vegetation. The overall width should be at least **1.8 m**, with a preferred minimum of **2 m**.



Safety ●●●●○
Comfort ●●●●○
Space ●●○○○
Cost ●○○○○

Curbside Buffered Cycle Lane

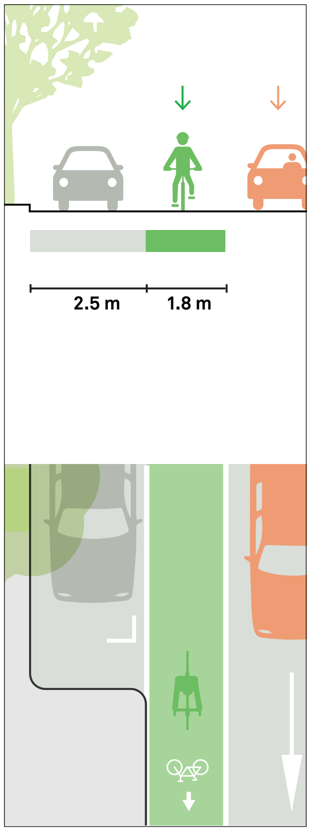
An exclusive clear path of at least **1.8 m** provides a dedicated path with pavement markings and signage adjacent to the curb. An additional buffer space of a minimum of **1 m**, and ideally **1.2 m**, is marked between the cycle lane and the roadway. It is most applicable when speeds are below **40 km/h**. As speeds or volumes increase, vertical separation increases safety and comfort. Cyclists remain visible to adjacent motorists and flexible bollards may be added in some cases.



Safety ●●●○○
Comfort ●●●○○
Space ●●●○○
Cost ●○○○○

Buffered Cycle Lane

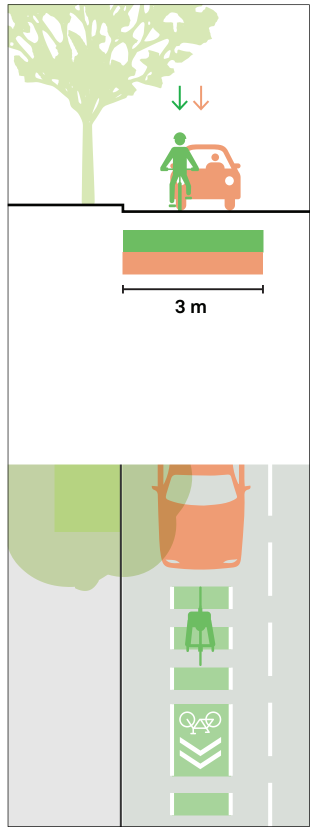
These are cycle lanes paired with a marked buffer separating the cycle lane from adjacent motor vehicles. A total cycle lane width of **3.2 m** is recommended to provide adequate buffers between parked cars opening doors on one side and moving vehicles on the other.



Safety ●○○○○
Comfort ●○○○○
Space ●○○○○
Cost ●○○○○

Conventional Cycle Lane

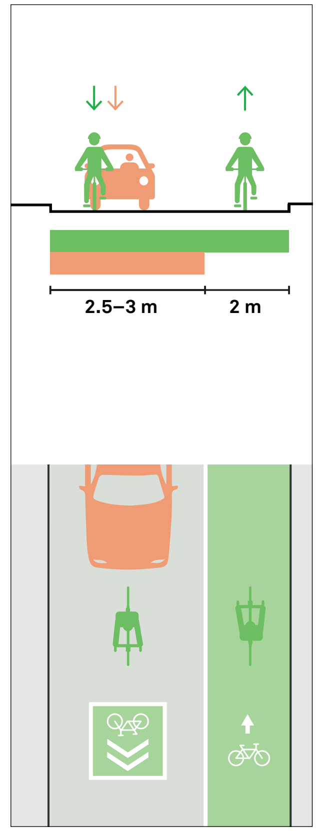
Exclusive space for cyclists is designated through the use of pavement markings and signage. The cycle lane is located adjacent to vehicular traffic and flows in the same direction, next to the parking lane. A minimum width of **1.8 m** should be provided, with a total minimum width of **4.3 m** between the curb and the outer edge of the cycle lane. It is most applicable when speeds are below **40 km/h**.[7] The conventional cycle lane is preferable to no facility at all, but it would be greatly improved by the provision of marked or physical buffers.



Safety ●●●○○
Comfort ●●●○○
Space N/A
Cost ●○○○○

Cycle Street

Also known as a Cycle Boulevard, Fahrradstraße in Germany and Fietsstraat in the Netherlands are quiet streets that accommodate high cycle flows and are accompanied by very low motorized traffic. Cars are invited to use the street as guests, and in some areas they have limited motor vehicle access. Cycle streets can be applicable where street width restricts dedicated cycle facilities.



Safety ●●●●○
Comfort ●●●○○
Space ●○○○○
Cost ●○○○○

Contraflow Cycle Street

Contraflow cycle streets are one-way streets in which cyclists are allowed to ride in both directions. Contraflow cyclists can either ride on a dedicated or an exclusive facility. They are most applicable for small-scale streets in which vehicular speeds are low. These facilities encourage more people to cycle, as they allow cyclists to use safe routes and direct routes, avoiding unnecessary detours. Contraflow cycle streets have been proven to be safer than other one-way streets.[8]

Cycle Facilities at Transit Stops

Cycle Track Behind Boarding Island

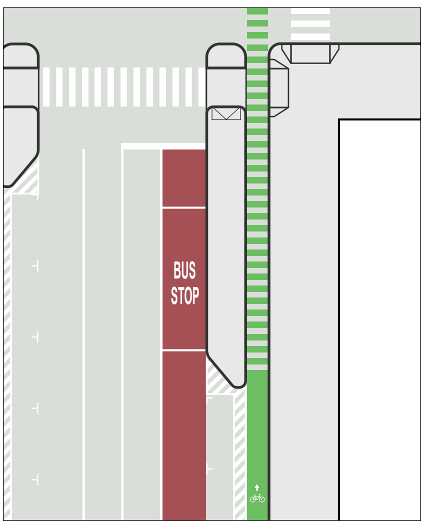
Curbside cycle tracks may be routed behind transit stops to maintain continuity while enabling better transit service. Cyclists are directed into a street-level channel which uses color and markings to inform cyclists of the expectation to yield to pedestrians.

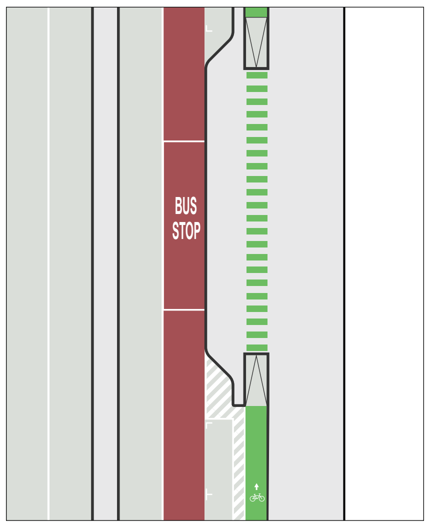
Cycle Track on Bus Bulb

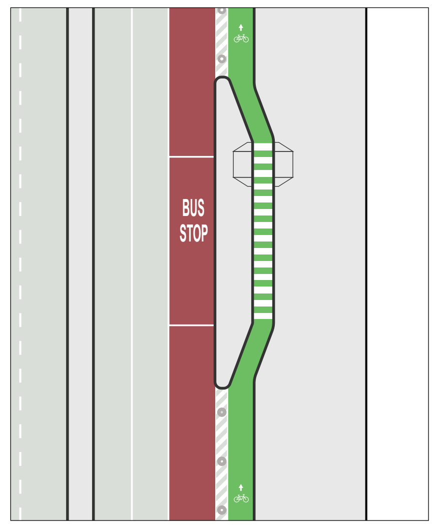
This design is most appropriate where transit ridership or cyclist volumes are relatively low. It provides the best pedestrian access to the stop, since the cycle lane is at the same level as the stop. Though the design favors pedestrians and may slow cyclists down, it also creates the most opportunities for conflicts.

Cycle Lane Behind Boarding Island

This design is most suited for streets with no parking lane, and it is the only design that does not require an extension into the roadway. The angled geometry forces cyclists to slow down in the cycle lane and should ensure that sidewalk paths remain safe and clear.







Protected Cycle Facilities at Intersections

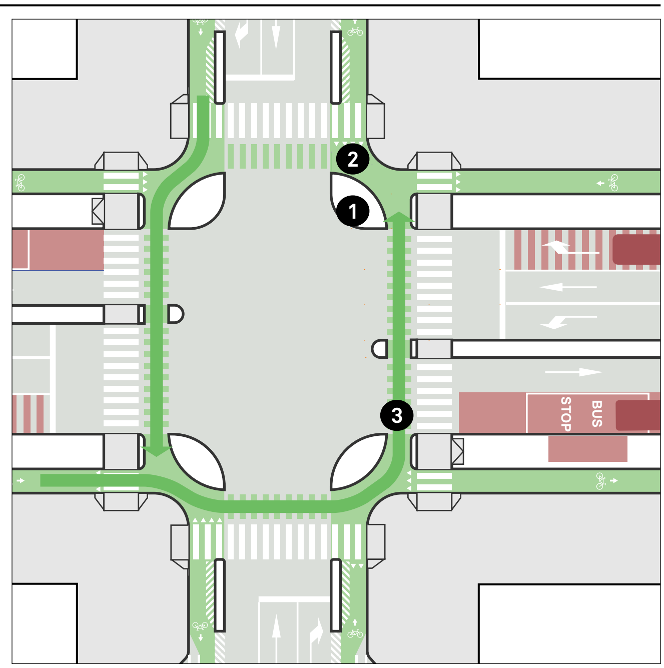
The protected intersection continues the physical separation of cycle facilities, positioning cyclists prominently ahead of right-turn conflicts and creating safe, simple cyclist movements through intersections. This can be achieved without moving existing curbs, with modifications making the intersection more compact and organized.

The protected intersection enables cyclist turns to be safe, two-stage movements aligned with concurrent traffic flow. Motor vehicles are prevented from encroaching in the cycle facility while turning by curb barriers and corner refuge islands. Cyclists are better placed in the sightline of turning vehicles, decreasing sideswipe and right-hook conflicts.

The slight curve of the cycle lane at the intersection in this configuration reduces cyclist speeds, making it safer for all users. Pedestrians also benefit from this design, as more waiting space and protection from vehicular traffic are provided in the form of curb extensions.

Main elements:

1. Corner refuge island
2. Forward stop line
3. Setback crossing by extending the curb



Cycle Signals

Dedicated cycle signals facilitate cycle travel through intersections. Depending on the signal type and cycle volumes in the network, they can be a phase of the signal cycle or can be activated by loop detectors or push buttons.

Cycle signal heads are cycle-specific signals that function similarly to traditional traffic signals. They often take the form of smaller or uniquely labeled versions of regular traffic signal heads, and may include countdown clocks.

Provide cycle signals at intersections to separate cycle and motor vehicle movements, especially where vehicles turn across cycle facilities. Cycle signals enable phase separation and may be timed with concurrent movements. They may also enable leading bicycle intervals, which allow cyclists to proceed ahead of motor vehicles, further enhancing safety and confidence. Dedicated cycle signals also facilitate cycle-only signal phases where a cycleway crosses a major street.

Amsterdam, The Netherlands

Filtered Permeability

Placing physical barriers at some intersections can manage vehicle volume by diverting motorized traffic, while allowing other modes to filter through. This prevents motorists from using residential areas as shortcuts and encourages continuous access in the cycle network.

The most common filtered permeability elements are diverters and refuge islands. These can be created with permanent materials or interim elements such as concrete barriers or planters, or concrete elements built into the roadbed.

Short contraflow cycle lanes on one-way streets may also be used to filter vehicle traffic. Filtering strategies may also calm vehicle speeds and enhance the safety of the cycling network.

Stockholm, Sweden

Conflict Zone Markings

At cycle crossings such as intersections, turn lanes, or in front of driveways, markings should be applied to the roadway that alert drivers and cyclists to potential conflict areas and guide cyclists across intersections.

Specific markings vary by location, but these areas should differ visually from the standard lane markings to highlight changing conditions to street users. Typically, dashed markings are used when cycle lanes are painted, and solid markings are used when cycle lanes are non-painted.

Conflict zone markings increase yielding behavior of motorists and emphasize the equal standing of cyclists within the street. Markings should continue all the way through the conflict area and at each conflict area along the corridor, such as at driveways.

Sydney, Australia

6.4.5 | Cycle Share

Around the world, cycle share programs are offering new transportation choices for people of all incomes. They extend the reach of existing transit systems, make one-way cycle trips possible, and eliminate some of the barriers to riding such as cycle ownership, access to storage space, maintenance costs, and concerns about theft.

Cycle share offers an opportunity to promote cycling in a city when it involves good system planning and is incorporated as part of a larger citywide strategy.

It is not a viable strategy unless combined with adequate facilities, comprehensive cycling networks, protected cycle lanes, and appropriate station density.

Cycle share trips are often very short. The average cycle share trip is about 12 minutes long, and user convenience is a fundamental consideration in the success of any cycle share program.[9]

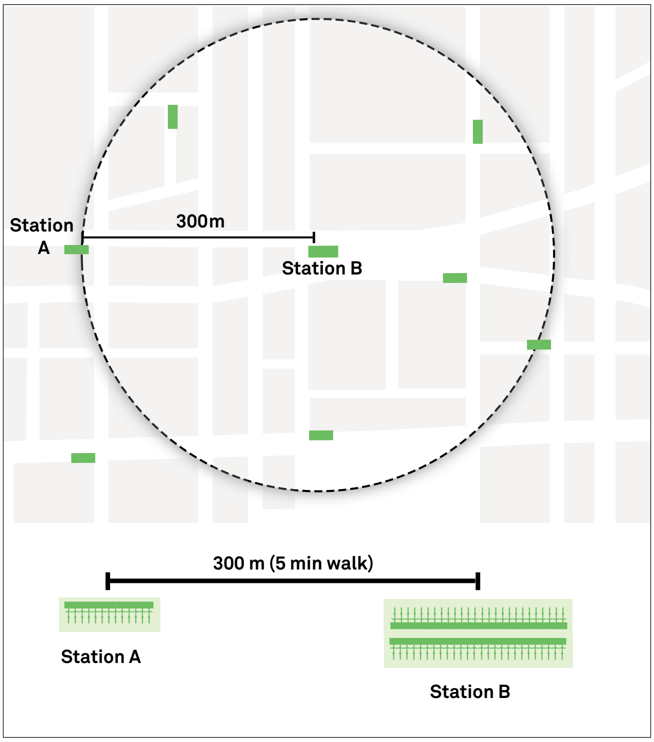
Program Coverage Area

For cycle share systems to offer a meaningful transportation option, they should cover large, contiguous areas that include a variety of neighborhoods, employment centers, cultural or recreational destinations, and high-density areas. Initial coverage areas should be carefully selected and strategically expanded in phases while maintaining critical station density and spacing across the entire system.

Program Density and Station Spacing

Cycle share usage is largely driven by convenience. So, having many options will increase overall ridership. While many people will comfortably walk **400 m** to reach a mass transit stop, it appears that the distance someone is willing to walk in order to use a bicycle is smaller, about **300 m**, or a 5-minute walk.

Since this distance remains the same regardless of neighborhood type, the size of the stations should be adjusted, not the spacing. When a station is full or empty, a user should be able to easily go to the nearest station to drop off or pick up a bicycle. Cities should ensure that stations are spaced no more than 300 m apart across the entire program area. This translates to an overall density of **11 stations per square kilometer**.



Station distance is fundamental to the success of a cycle share system. Stations should be located no more than 300 m apart.

E-BIKE SHARE SYSTEM IN COPENHAGEN

E-bike share systems provide pedelec bicycles whose pedalling is assisted by a small electric motor. These types of bicycles are particularly helpful for elderly people and can encourage people to cycle in hilly cities. Pedelecs reduce effort, decrease the time to reach a destination, and increase the range of destinations. In some cases, digital wayfinding screens are included on the bicycle.

Copenhagen, Denmark. This share system provides pedal-assist e-bikes with built-in wayfinding screens.

Station Placement

Consider key destinations such as transit stations, schools, office districts, commercial corridors, and tourist attractions in the placement of cycle share stations.

On-street cycle share stations can be placed on parking spaces. On-street stations also assist in traffic calming and street safety efforts by helping define pedestrian and cycle spaces and increasing visibility at intersections.

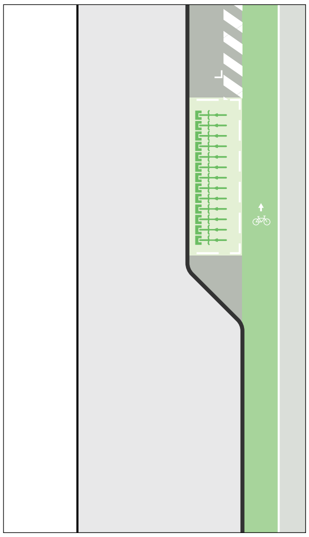
Stations should ideally be placed near cycle lanes and should never impede clear and safe pedestrian flow. Opportunities can be found:

- In parking spaces adjacent to sidewalks
- In parking spaces adjacent to cycle lanes
- On wide sidewalks
- In adjacent public spaces, parks, or destination sites outside the public right-of-way

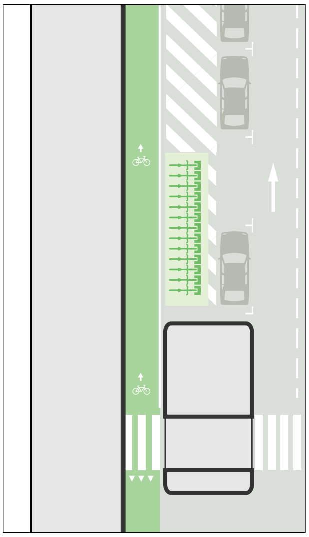
Station Dimensions and Types

Cycle share stations generally include no fewer than 15 docks and can accommodate more than 100 at very high demand locations. Some cites use hardwired stations, which require digging and trenching. Although they have a better appearance, they require more construction time. Alternative systems are installed on plates and are generally less expensive and faster to install.

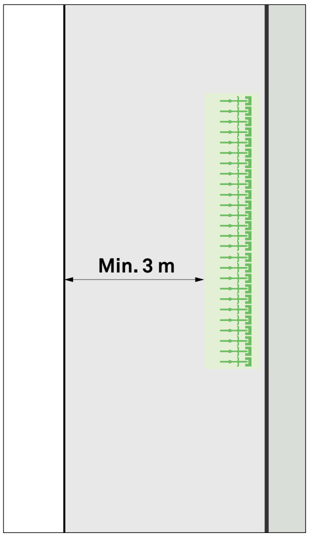
Cycle Share Station Configurations



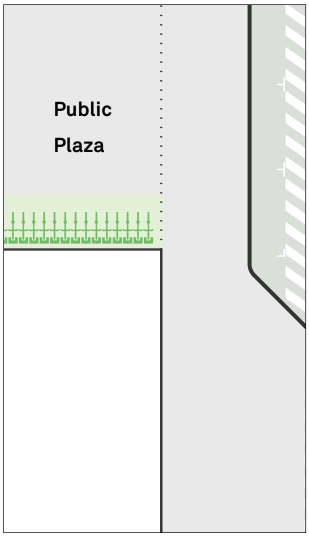
Configuration 1: Parking spaces adjacent to sidewalks.



Configuration 2: Parking spaces adjacent to cycle lanes.



Configuration 3: On wide sidewalks.



Configuration 4: In adjacent public spaces, parks, or destination sites outside the public right-of-way.

CYCLE SHARE; HANGZHOU, CHINA

The city of Hangzhou started a cycle share program in 2008 and has now the largest system in the world, with 66,500 cycles operating from 2,700 stations. Stations are located around bus stops and water taxi stations. The first 90 minutes of usage are free if transferring from a public bus or metro. The system is seen by locals as the best way to complement mass transit.

The high number of cycles and stations, along with the very wide protected cycle track network, are vital to the success of the system.

Hangzhou Cycle Share System

6.5 | Designing for Transit Riders

6.5.1 | Overview

From small collective vehicles to fixed-route bus and rail services, collective transport (or transit) offers a sustainable and efficient way to move people in an urban setting. Transit is complementary to walking and cycling, allowing mass mobility for longer trips without mass use or ownership of private vehicles.

Transit systems are inherently tied to land use and density. Specific challenges and opportunities for the creation or the improvement of transit systems will vary greatly with context and local financial investments.

While equitable provision of transit is not easy, it is key to the development of a sustainable city.

Dedicate space to collective transport to facilitate safe, reliable, and frequent transit service. Exclusive at-grade facilities within the street increase the overall efficiency and capacity of the systems by reducing delays caused by mixed traffic operation. This can be very cost-effective, especially if compared to elevated or underground facilities.

Improved on-street transit infrastructure needs to be complemented with sufficiently updated transit vehicles and vice versa.

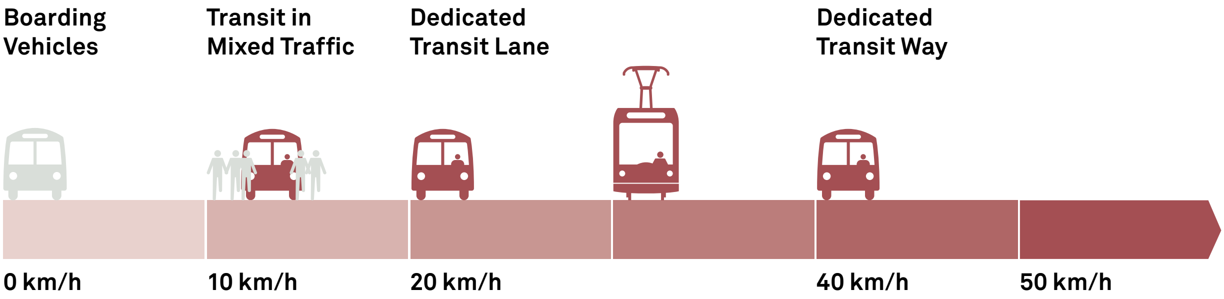
As collective transport services increase reliability and ridership, they attract new activities and street vitality. This requires careful design and operation decisions to maintain transit movement in a pedestrian-friendly and safe environment for all users.

Providing dedicated space within the street helps transit networks to provide reliable, convenient, and frequent service to passengers without delays from mixed traffic, while increasing the mobility capacity and environmental sustainability of the city.

Speed

Transit travel time is affected by the type of transit facility, whether exclusive, dedicated, or mixed. It is also impacted by the travel lane width, enforcement, signal priority, and the type of service and vehicle. The same service may have different transit facilities along the same corridor, according to the context, mix of uses, or street width.

Maximum speeds for transit vehicles should be determined based on safety needs and the street context. In urban streets, speeds should not exceed **40 km/h**, and in central city or neighborhood streets where there are high volumes of pedestrians or other users, maximum speeds should be **15–20 km/h**. Dedicated facilities help transit speeds to be maintained efficiently by avoiding congestion in mixed traffic. In shared transit streets with people walking in the same roadbed as transit vehicles, speeds should be as low as **10 km/h**.

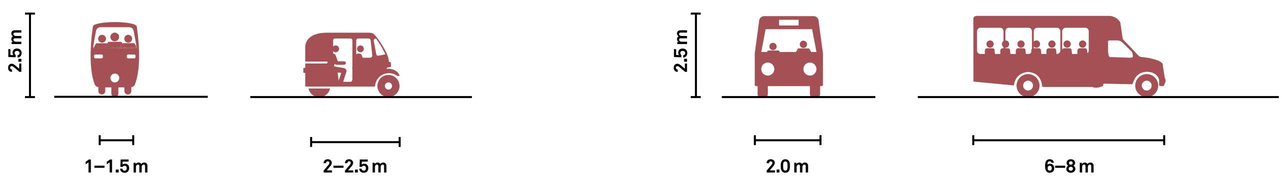


Variations

Vehicles used for collective transit vary by capacity, comfort, speed, and cost, but they can all contribute to creating comprehensive networks. The choice of vehicles in the system will impact the level of carbon emissions, air quality, ride quality, and noise levels for residents along designated routes. Vehicle choice should be driven by these issues as well as passenger capacity and comfort, operating expenses, and sustainability.

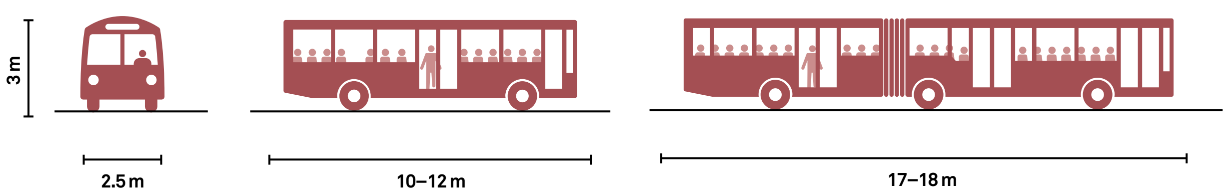
Small Collective Transport Services

Small collective transport vehicles are a common form of low-cost transportation around the world. It generally involves the use of small-sized vehicles for shared passenger transport. Small collective transport services develop in varying degrees of formality and are closely responsive to demand. These services often provide critical access where mass transit does not exist. While they do not have dedicated travel lanes, streets should include spaces for stops, boarding, and transfers.



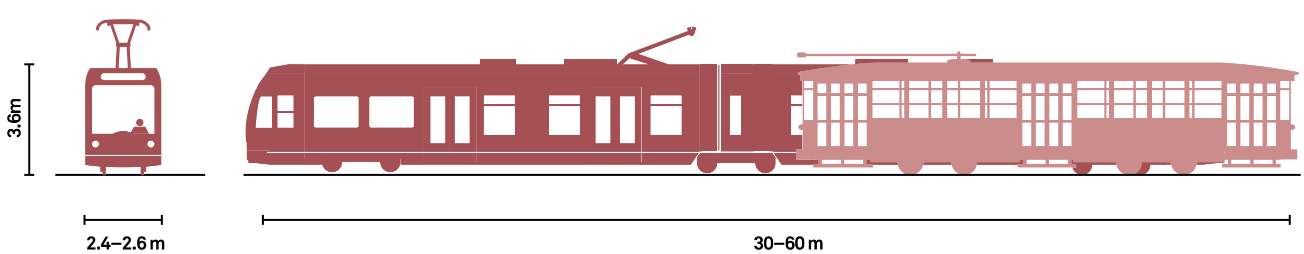
Bus Services

Fixed route local buses are the foundation of urban transit, and are the mode most frequently missing in cities with an informal transport sector. Vehicles vary from standard buses to larger, articulated buses and can run on local or express routes and schedules. Bus Rapid Transit (BRT) is a particular type of high-capacity, limited-stop service, running on exclusive infrastructures called transitways. BRT systems include stations, off-board fare collection, and longer stop spacing than local buses. They employ high-capacity vehicles such articulated or bi-articulated buses.



Urban Rail Services

Like buses, rail services can be used in the full spectrum of urban contexts. Urban rail services such as trams and streetcars run at grade on the street, either in mixed traffic or in separate lanes. Light Rail Transit (LRT) and modern tramways are used for high-capacity transit and employ dedicated facilities. While rail services operate at slower speeds in urban streets, they improve public space quality and can be organized as part of a network, operating at different speeds in different contexts.



6.5.2 | Transit Networks

Transit network planning directly influences street design. Major routes with frequent service demand higher priority in street space allocation. Collective transport can provide convenient and reliable service given thoughtful geographic consideration and priority within the streets.

Geographic coverage of a transit network is relevant to both equity and efficiency. Transit networks are inherently linked to comprehensive planning that shapes land use and density decisions, and should be carefully coordinated. Transit systems can strategically attract new development and offer economic benefits to local businesses.

Prioritizing collective transport with dedicated on-street facilities helps a city move large numbers of people quickly and efficiently. This allows dedicating space within the street for other uses and supports sustainability goals.

Quality pedestrian environments around stops and stations, and easy access to cycle infrastructure such as cycle share, cycle lanes, and secure cycle parking spaces are critical to the success of a comprehensive mobility system.

Multiple collective transit systems can work together on urban streets to create a comprehensive and reliable network. Consider the following variables when designing or improving transit networks through street design.

Network Type

Network type is a contextual consideration in street design. The planned or existing network affects the efficiency of a mass transit system. Grid networks on major streets connecting to large employment activity hubs are the most competitive form in most cities allowing transfers between lines and access to the whole city.

Service Type

Service frequency, capacity, stop spacing, and destination density are major influences on street design. High-capacity services can offer greater speed, increased trip distance, and reliability, while local routes bridge shorter gaps, but with lower speeds and capacity. Effective networks employ a mix of service types based on contextual considerations and demands.

Network Directness and Legibility

Identify key travel and commuting corridors to help plan direct and frequent service and serve locations where less formalized transit bridges first- and last-mile gaps. The transit system must accommodate both the regular user and the first-time rider, providing predictable, reliable, and legible service.

Station Planning

Create dense and mixed-use developments around transit stops to increase transit ridership. Provide a high-quality public realm, walkable streets, comfortable station design, and interchange between complementary modes to further attract ridership, and compound transit benefits. Small collective transport generally offers a flexible operation when stops are not necessarily established or formalized. Planning stops for these type of services can be beneficial for both mass transit and small collective transport.

Network Integration

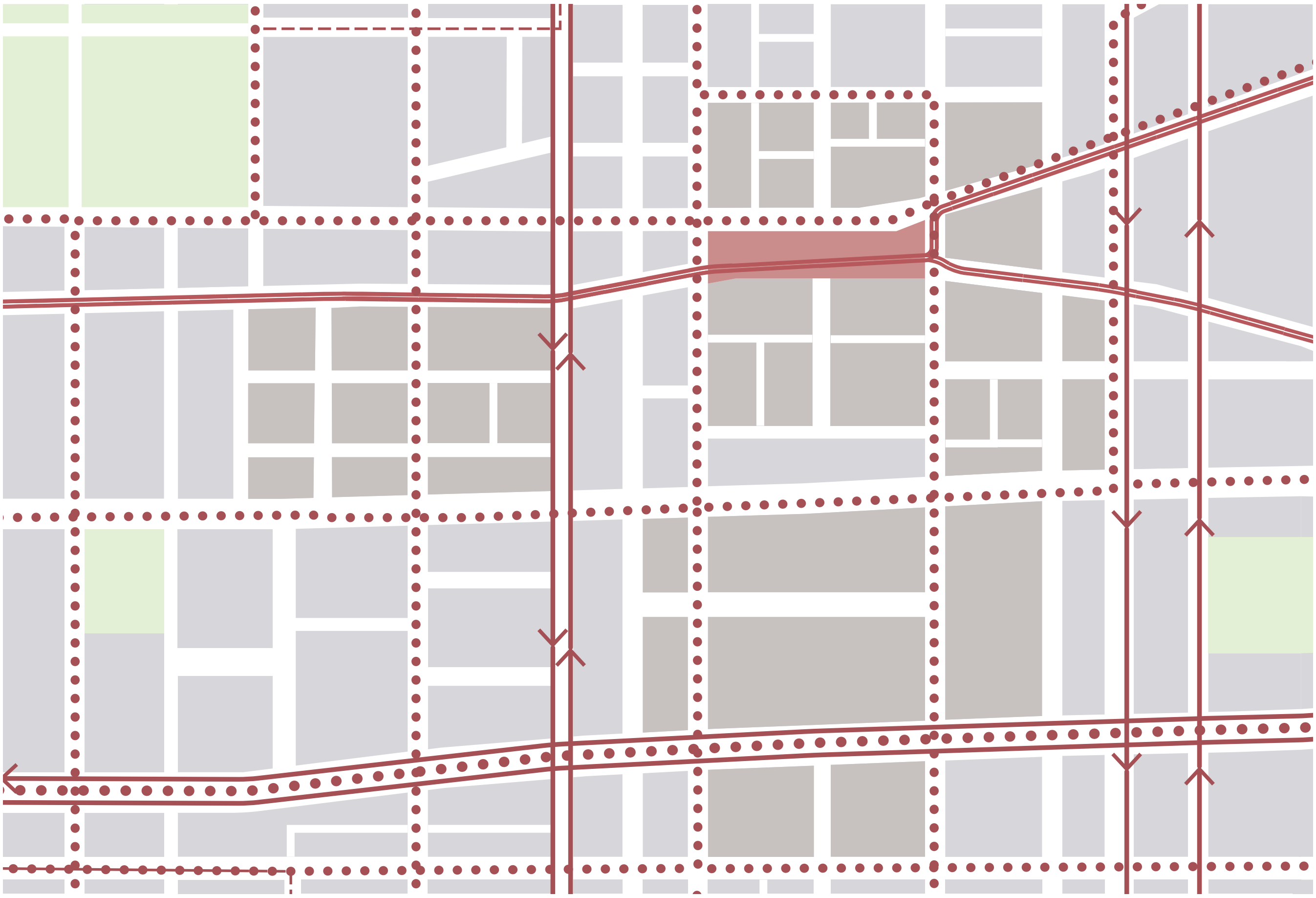
Integrated transit services extend network connectivity and increase the area covered by transit, encouraging modal shifts. Design quality transfer points to facilitate the safe integration between different types of transit services, such as rapid mass transit and local collective transport.

Performance

Measure transit network performance based on the user ability to conveniently reach destinations and the cost to do so. Fixed routes at predictable intervals with broad coverage areas and frequent services perform well for passengers. A single metric, such as the average travel time in a system, is not sufficient. Create system-wide measures such as the number of jobs an average resident can reach in 30, 45 or 60 minutes. *See 3: Measuring and Evaluating Streets.*

MAPPING COLLECTIVE TRANSPORT NAIROBI, KENYA

Nearly one-third of citizens in Nairobi, Kenya use the city's Matatu system of privately owned minibuses, but it was only recently officially mapped. A collaborative project of the University of Nairobi, Columbia University's Center for Sustainable Urban Development, MIT's Civic Data Design Lab, and Groupshot, Digital Matatus has been using crowd-sourcing data collection through mobile phones to standardize transit data for Nairobi's Matatus, making the maps available to the public for the first time.



Transit Networks: Great transit networks provide a hierarchy of services that facilitate trips both long and short, crosstown and local. Concentrate investments on congested and high-volume corridors, while ensuring that geographic coverage serves all communities equitably. Plan transit networks for legibility, with an understanding of how riders use the system. Collective transport mode is less important than service frequency and destination access.

- Transit street
- Transitways
- Transit lanes
- Transit routes (mixed traffic)
- Local routes or dial-a-ride

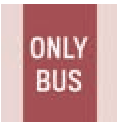
Guangzhou, China. This BRT system opened in 2010 and travels in a dedicated transitway.

Helsinki, Finland. A transit street with one of the world's oldest electrified tram systems.

São Paulo, Brazil. Transit shelters line corridors with high transit ridership.

6.5.3 | Transit Toolbox

Effective transit systems are supported by critical infrastructure elements within the streetscape for universal access, improved efficiency, and increased legibility and comfort.

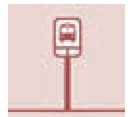


Transit Lanes

On-street transit lanes improve travel time and performance and relieve transit congestion by allocating space for the dedicated use of transit vehicles. Transit lanes are demarcated by signs and pavement markings. They can be peak-only or all-day depending on the needs of transit services and operations. Pavement should be colored to reinforce lane designation and to improve motorist compliance with the lane restriction.

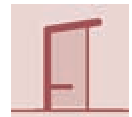
Transitways

On-street transitways are exclusive lanes for transit that are physically separated by vertical elements such as planted medians, concrete curbs, bollards, or half domes. They are commonly used with BRT and LRT services and provide prioritized transit routes with fast and high-capacity service.



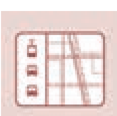
Transit Stops

Transit stops are clearly marked areas that indicate where a given transit line stops for passengers. They include signs, route numbers and names, wayfinding information with destinations, schedules, and maps. Transit stops should provide seating for waiting passengers, and maintain clear paths for walking and universal access. Stops should allow vehicles to load to a sidewalk or an island from the transit lane without pulling out of traffic.



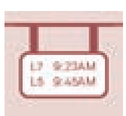
Transit Shelters

Transit shelters should be provided to offer seating for waiting passengers, allowing space for people with strollers and in wheelchairs. When sidewalk space allows and clear paths can be maintained, overhead protection and vertical partitions should be used to offer shelter from weather. Vertical partitions should be transparent to provide safety and visibility to waiting passengers.



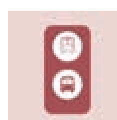
Wayfinding

It is critical that transit systems are easy to understand and use. Routes and schedules should be displayed on maps posted at all stops and stations, showing information such as destinations, travel times, frequency, and transfer points. Use multiple languages and visual symbols to reach a broader audience, and tie wayfinding information at stops to mobile applications or text-based systems.



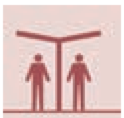
Real-Time Arrival Information

Real-time arrival information increases legibility, reduces travel time, facilitates complex trip planning, and improves rider satisfaction. Provide real-time information where stations serve multiple routes to clarify services and destinations. Arrival information can be displayed on full-color or LED signs, or be available by phone, SMS, or online. This information should be made freely available to allow the development of online trip planning tools for desktop and mobile applications.



Transit Signals

Active transit signal priority improves transit efficiency by reducing dwell time at traffic signals. Approaching transit vehicles can activate signals to shorten red lights or lengthen green phases. Transit-friendly signal progressions may be applied on frequent corridors, which time signals for realistic transit speed and progress with reduced impact on motor vehicle delay. Low-speed progressions also benefit cyclists.



Transit Stations

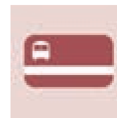
Transit stations are larger structures on wider streets or medians, used in conjunction with high-ridership routes or when multiple routes intersect. The design should reflect the volume of passengers and their likely paths of travel. Space for commercial activities or services may be provided to enhance the transit rider experience. Stations should be designed to connect each side of the street.

Accessible Boarding Area

Every transit stop must provide a boarding area that allows people using wheelchairs access to the transit vehicle. If the entrances are not all accessible, specific vehicle entrances should be clearly marked and indicated in the boarding area.

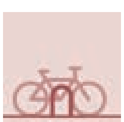
Seating

Provide seating to increase accessibility of transit systems for elderly users and those with physical impediments. Seating can be provided within transit shelters or as stand-alone elements in the sidewalk amenity zone, and should offer full or partial backs. Seating must be organized to provide clear pedestrian paths and boarding zones. More seating should be provided where there is higher demand, or where there is heavy use by seniors or persons with disabilities.



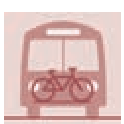
Ticket Vending Machines

Provide ticket vending machines so passengers can purchase tickets before the vehicle arrives to speed up the boarding process and improve overall efficiency. Ticket vending machines should maintain clear paths for passing pedestrians and be combined with clear information about the process of purchase. Use multiple languages and visual symbols to reach a broader audience.



Cycle Parking

Cycles should be used in conjunction with transit service to fill last-mile gaps. Provide dedicated and secure cycle parking racks or areas next to all transit stops. When high volumes of cycle riders frequent stations, shelters or structures may be required. Install cycle share stations near transit stations to connect last-mile trips.



Cycle on Transit Vehicles

Cycle racks inside the vehicles or exterior racks on the front of the vehicles may be provided to support cycle use. When specific areas are allocated for cycle use inside the vehicles, clear indications should be provided on vehicle doors and at the boarding platform area. Where capacity may be limited, allowing bicycles on long-haul transit is especially important for riders.

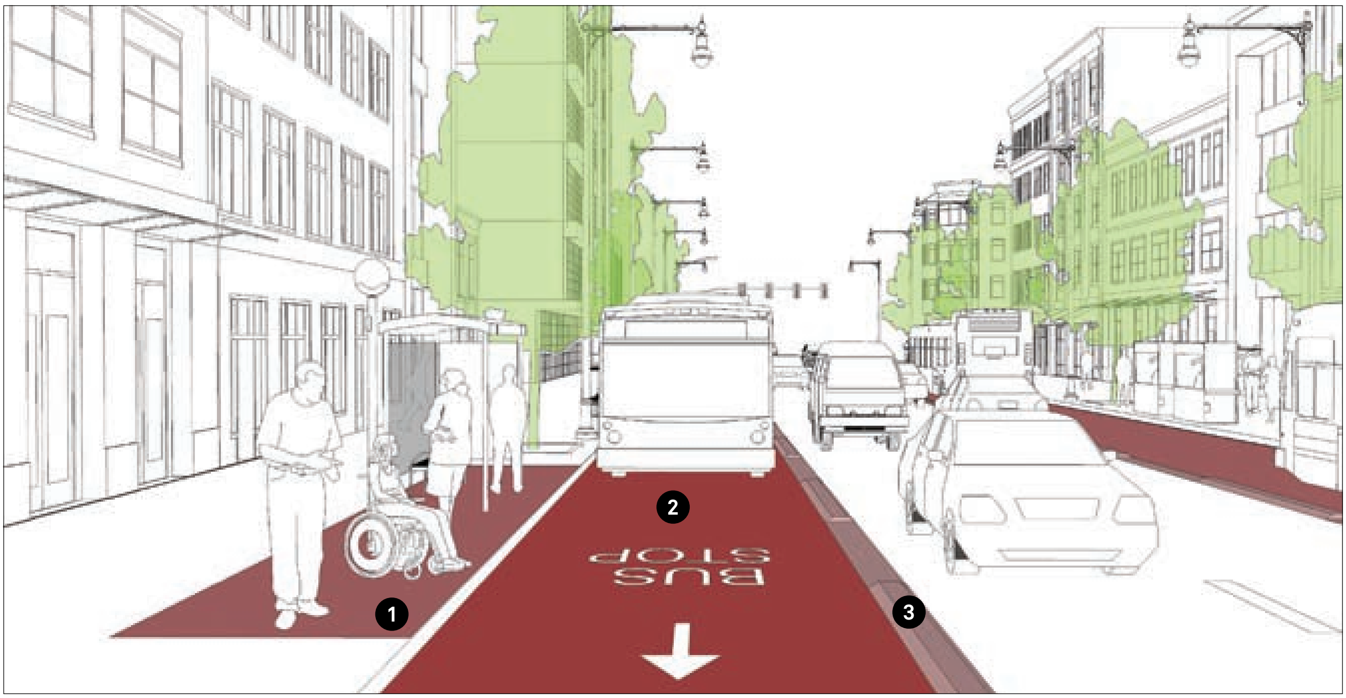
Waste Bins

Transit stops and stations can attract high volumes of people, sometimes eating, drinking, reading, or partaking in other activities while waiting. Provide places for them to dispose of their waste to reduce overall maintenance requirements and keep spaces clean and tidy.

6.5.4 | Transit Facilities

Transit facilities can consist of dedicated space within the right-of-way, exclusive facilities such as transitways, or shared facilities such as transit streets. Separated transit facilities are preferred as corridor volume increases since greater separation allows for safer and faster movement of transit.

The decision of which transit facility to implement should be informed by the context of the facility and the expected ridership of the transit service. Transitways are optimal for high-occupancy, continuous corridors; transit lanes for core corridors with medium to high ridership and flexible routes; and shared transit streets for areas with heavy pedestrian volumes.



Transit Stop or Stop Zone

1 The stop zone is the space designated for the waiting and boarding of transit riders and can be integrated into the sidewalk, the median, or on a dedicated boarding island.

When curbside, the stop zone is adjacent to the pedestrian clear path. Shelters, seating, signs, and transit information must be located so as not to impede pedestrian accessibility. The stop zone may also be aligned with the parking lane or cycle lane, and may include green infrastructure or other curbside amenities at non-stop locations.

Transit Running Way

2 Most transit vehicles are **2.4–2.8 m** wide, excluding mirrors; a **3 m** width allows for a comfortable low-speed operating space, so long as there is flexible buffer space adjacent to the transit running way (such as a parking lane, cycle facility, or marked buffer). When operating along the curb or in a bidirectional transit configuration, a **3.3–3.5 m** width allows for comfortable operation with low risk for mirror clips or sideswipes. Designate exclusive transit running way with pavement markings and signs.

Buffer Zone

3 The buffer zone may simply be extra roadway width assigned to the transit lane, or may be more defined, such as medians or marked/constructed buffer. Vertical features must not interfere with safe transit operation.

Facility Types

Transit Lanes

Transit lanes are a portion of the street designated for the preferential or exclusive use of transit vehicles, sometimes permitting limited use by other vehicles. They are often repurposed from a general traffic lane, designated by striping, signage, and pavement markings. Transit lanes allow transit vehicles to easily enter and exit the lane to suit their route.

SÃO PAULO, BRAZIL

São Paulo's dedicated bus lanes, Corredores de Onibus, are a 320 km-long network across the city. These exclusive bus lanes have decreased travel times for users by 18.4% as the travel speeds for buses has gone up, on average, from 13.8 km/h to 16.8 km/h. Started in 2005, these lanes have grown to carry over 77% of collective transit users in the city. Enhanced speeds and reduced traffic congestion have also reduced the CO_2 emissions for the city by 1.9 tons per day.

Transitways

On-street transitways are exclusive transit facilities physically separated from mixed traffic roadway by medians or other vertical elements. They are often implemented to ensure reliability of high-frequency/high-capacity transit services such as Bus Rapid Transit, light rail service, or modern tramways.

BOGOTÁ, COLOMBIA

Bogotá has the world's busiest BRT system, Transmilenio, with 12 lines serving 144 stations and more than 100 km of exclusive transitways. It accounts for 4 million trips each day and a mode share of about 64% of all trips in the city. A key to the success of the Transmilenio has been the partnership between public and private agencies; while the city planned and built the system and continues to regulate and manage it, the buses are run by private companies.

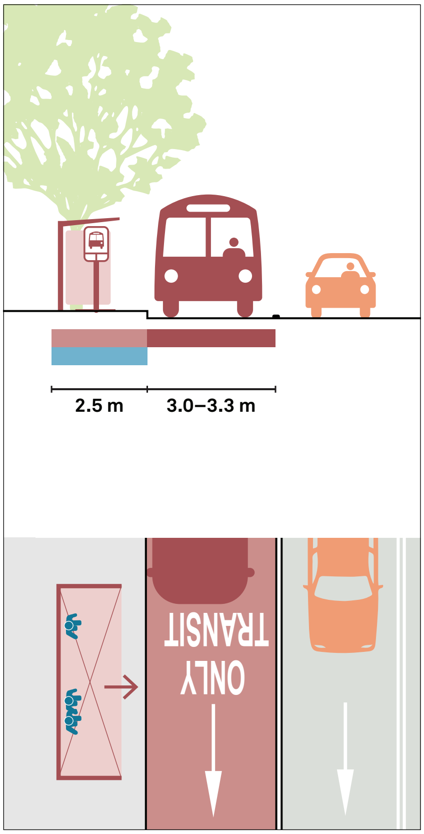
Transit Streets

Transit streets prioritize the street for pedestrians and collective transport. Vehicular traffic is prohibited beyond limited deliveries and permitted access. Transit may have dedicated spaces between sidewalks; the street can be designed as a shared space (shared transit street) with no sidewalks, or any other demarcation, allowing transit to move slowly through the pedestrian space. Maximum speeds should not exceed 10–20 km/h.

JAFFA STREET JERUSALEM, ISRAEL

Jerusalem opened its light rail corridor on Jaffa Street in 2011, restricting the street to pedestrians and transit users. It is a 2.5-km stretch in the heart of the old city and is supported by ancillary transit streets and pedestrian-only streets. Lined with shops, the street used to be one of the most polluted in the city. The new character of the street has helped revitalize the area and has resulted in increased property values.

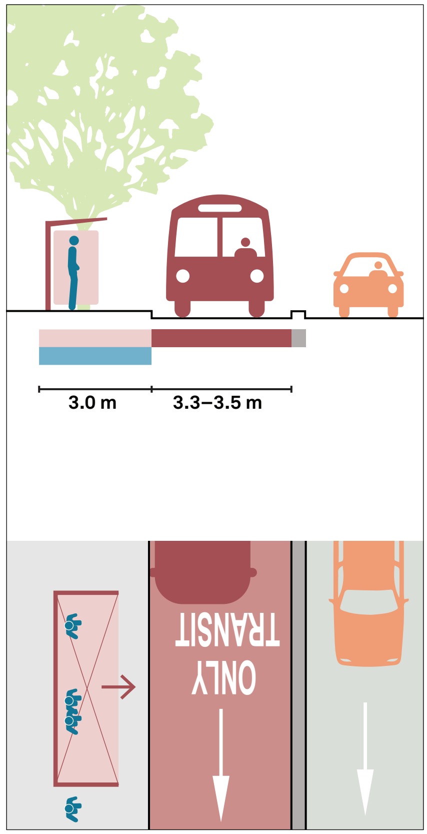
Geometry



Capacity ●●○○○
Speed ●●○○○
Space ●○○○○
Cost ●○○○○

Side-Running Dedicated Transit Lanes

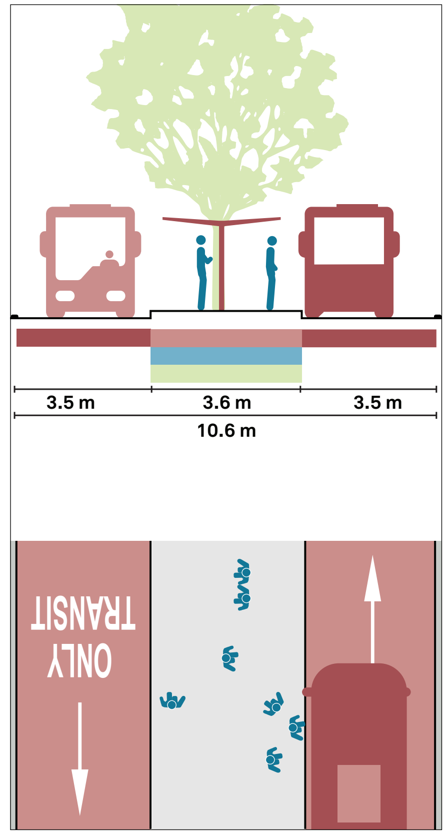
The recommended width for a side-running dedicated transit lane is **3–3.3 m**. Transit lanes, unlike on-street transitways, are not physically separated from other traffic. Lower capacity systems can allow for adjacent parking and loading lanes when coupled with curb extension transit stops to allow in-lane transit boarding.



Capacity ●●●○○
Speed ●●●○○
Space ●●○○○
Cost ●●○○○

Side-Running Transitways

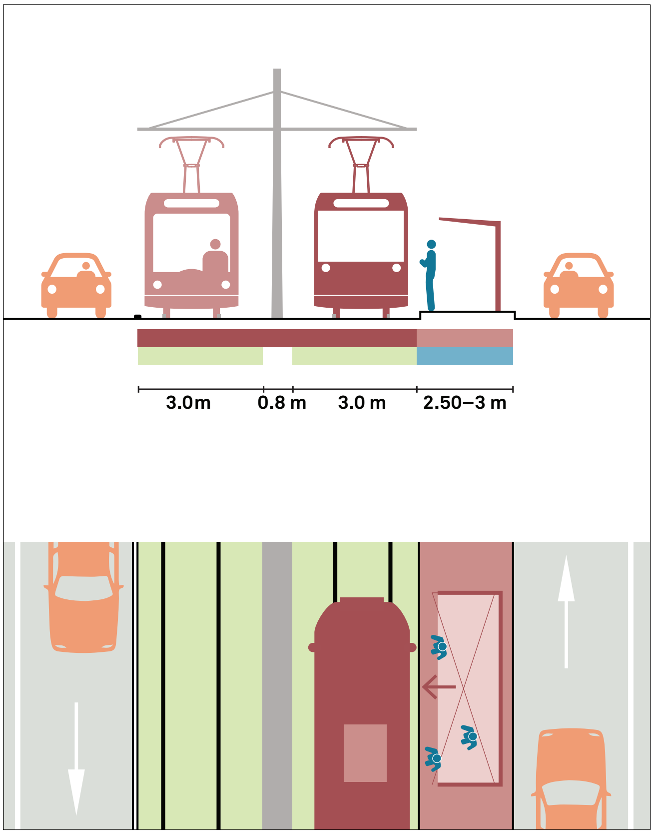
Placing a transitway in an exclusive space separated by vertical elements such as medians improves travel times and predictable movement by reducing conflicts with parked cars, cycles, and some turning movements. Side-running transitways are applicable for high-frequency transit service, especially bidirectional service where turns and curb cuts across the transitway are very limited. To avoid conflicts with transit vehicles, left- and right-turning traffic must be prohibited or accommodated using turn lanes with dedicated signal phases. Widths of **3.3–3.5 m** are recommended, as are complementary elements such as all-door boarding, transit signal priority, and level boarding.



Capacity ●●●●●
Speed ●●●●○
Space ●●●○○
Cost ●●●○○

Center-Running Transitways with Center Boarding

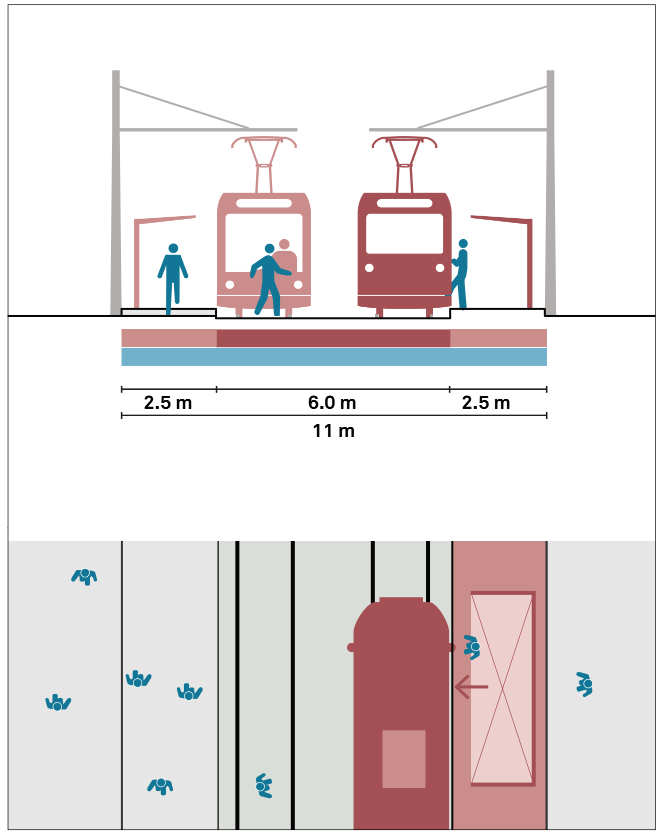
Center-running transitways can serve BRT and LRT with potentially very high capacities and frequencies. Center loading allows the use of the same platform for trips in both directions and reduces construction costs. The recommended station width is **3.6 m** or greater. Center lanes eliminate conflicts with curbside loading, parking, and drop-offs, and require passenger doors on the driver's side of the transit vehicle. To avoid conflicts, turns across the transitway should be prohibited or accommodated using turn lanes and signal phases. Lanes should be **3.3–3.5 m** wide, and at-grade crossings should be provided at frequent intervals to ensure access from both sides of the street.



Capacity ●●●●●
Speed ●●●●●
Space ●●●○○
Cost ●●●●●

Center-Running Transitways with Passenger-Side Boarding

Center-running transitways are separated from other vehicle traffic by medians, while side-loading accommodates right-side boarding buses or light rail systems. Center-median transitways provide high-capacity and reliable service, and requires a width between **10–12.5 m**, depending on how stations are staggered. Installation should be coordinated with land use changes that maximize potential for transit-oriented development.



Capacity ●●●●●
Speed ●●○○○
Space ●●●●○
Cost ●●●●○

Shared Transit Streets

Shared transit streets share priority between transit and pedestrians, operating in car-free streets. Typically designed for busy blocks of commercial or neighborhood corridors, shared transit streets may allow restricted vehicular access and deliveries at specific hours. Most commonly designed with light rail or tram systems, they can also accommodate bus and BRT. Transit vehicles run in a predictable, dedicated path, flush with adjacent pedestrian surfaces, except at transit stops where raised platforms facilitate level boarding. Speeds are reduced generally to 10–20 km/h to facilitate pedestrian permeability across the street and support a quality public space.

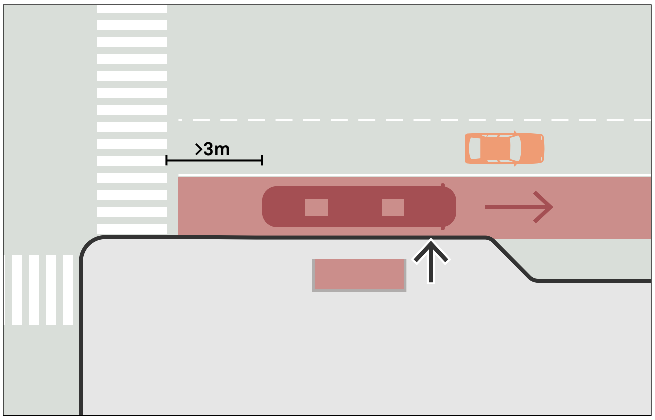
6.5.5 | Transit Stops

Stop Types

Transit stop configurations should be based on transit typology, vehicle dimension, capacity, ridership, and frequency. The illustrations below show six of the most common configurations for transit stops. Each of these must be studied in relationship to the local context and can be used with a variety of vehicle types.

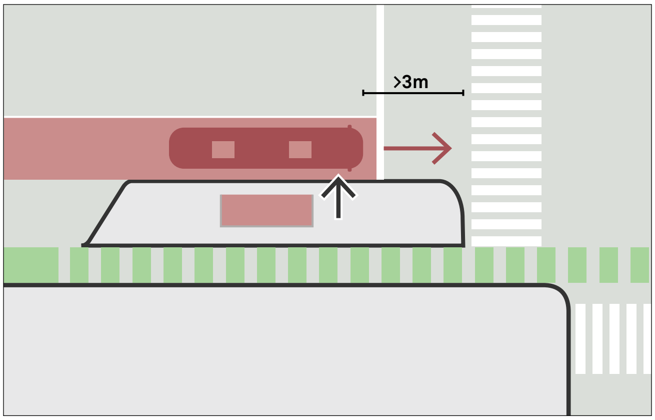
In-Lane Stops

These stops allow transit vehicles to pick up passengers without exiting the lane, thereby reducing transit dwell time. In-lane stops are applicable where transit operates in a dedicated lane where motor vehicle volumes prevent buses from reemerging from stops or where travel speeds are low to moderate. In-lane stops confer transit the highest priority.



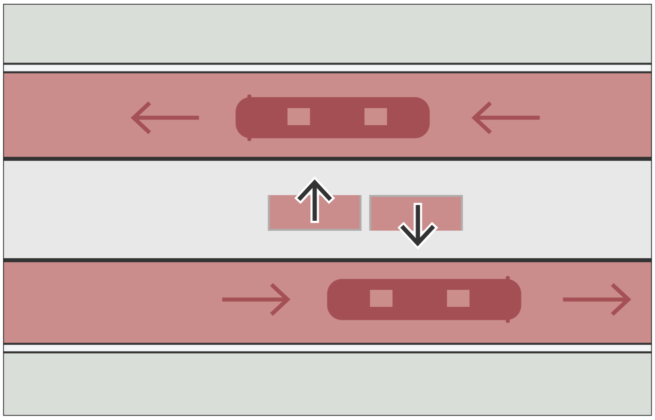
Island Stops

These are platforms flanked by travel lanes on both sides, allowing transit vehicles to run in the center lane where there are fewer conflicts with other users. They provide a dedicated space for passengers to wait. They should be located adjacent to pedestrian crossings, where passengers can easily access the pedestrian crossing. Separate island stops are required for each direction of transit service. Stops may be staggered, which can allocate space for turn lanes while providing the benefits of far-side stops for both travel directions.[10]



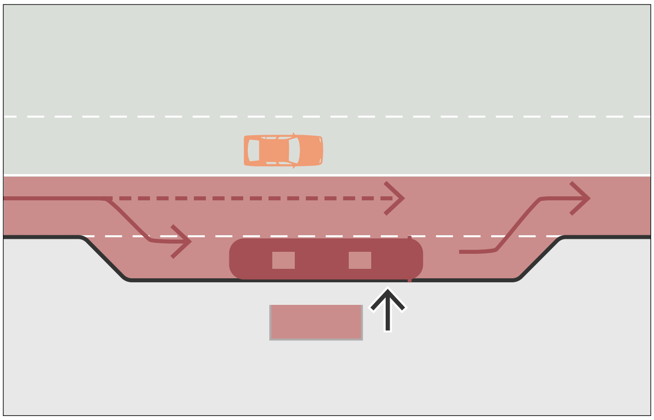
Median Stops

These stops are located in the center of a street and serve transit lines in both travel directions on both sides of the platform. They require transit vehicles to have doors on the driver's side. Access to median stops should be provided through conventionally located, at-grade pedestrian crossings.



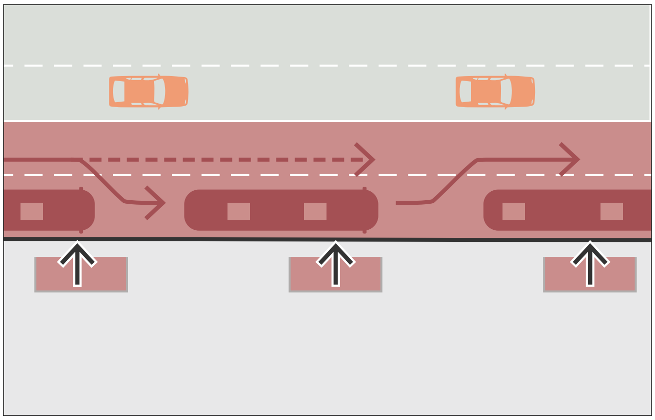
Pull-Out Stops

These stops provide a bay for transit to pull into the curb for boarding, allowing other vehicles to pass. On streets with dedicated transit lanes, pull-out stops should only be used to allow rapid service to bypass local service, enabling intra-route transfers or to enable buses to bypass vehicles queued at intersections. Pull-out stops or bus bays may also be appropriate where buses must stop and wait for a period of time, such as at the end of a route or at a high-traffic transfer point.



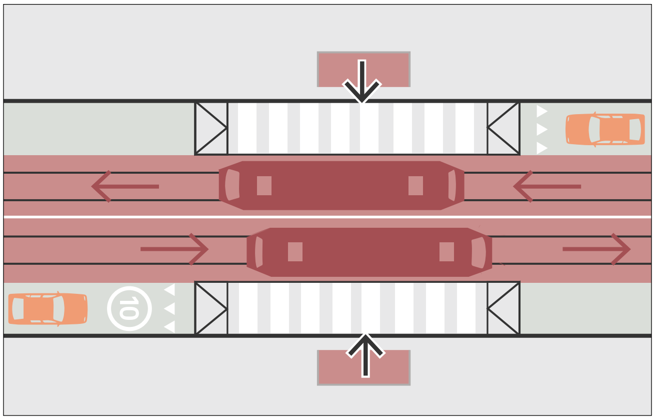
Boarding Lanes and Transit Stands

Boarding lanes are provided at specific locations such as transfer points, hubs, or key destinations to improve transfer efficiency by providing designated locations for specific routes. Good design and enforcement reduce conflicts and increase safety at these locations, especially in crowded environments. The recommended width for these lanes is **3 m** for minibuses.



Shared Stops or Easy Access Stops

These stops share the loading space for waiting transit users with vehicular travel lanes. Pedestrians wait on the sidewalk and when the transit vehicle arrives, cars, cycles, and other vehicles stop at the raised travel lane behind the transit vehicle, allowing pedestrians level boarding access. Once the transit vehicle leaves the stop and disembarking passengers have left the shared space, vehicles and cycles can resume movement. This type of stop is highly dependent on local context, compliance levels, and enforcement.

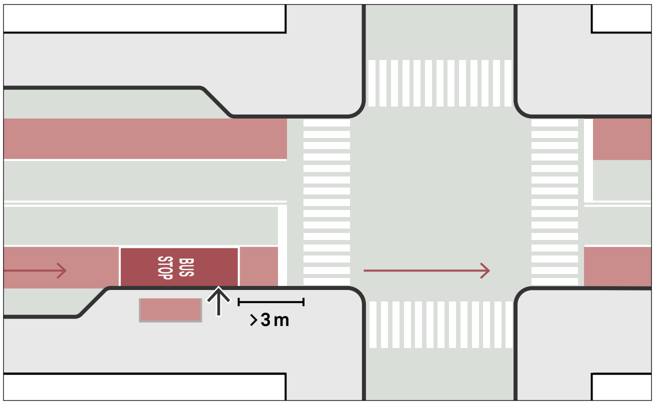


Stop Placement

Transit stops may be located at the near or far side of the intersection, or may be located mid-block in limited circumstances. Stop location affects transit speed, capacity, safety, transfer opportunities, walking distances, and conflicts with other users. The opportunity of each placement should be analyzed with consideration to the local context.

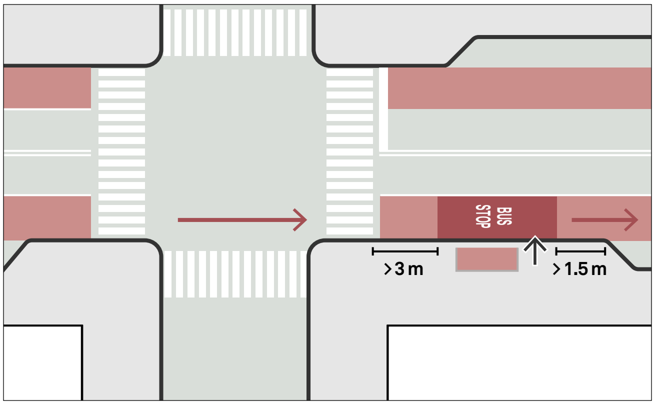
Near-Side Stops

Near-side transit stops are located immediately before the intersection, allowing passengers to board and disembark within close proximity to the pedestrian crossing. Near-side stops are typically appropriate where limiting factors exist on the far side of the intersection. This configuration can allow passengers to board while transit is stopped at a red light, but reduces visibility between users at the intersection.



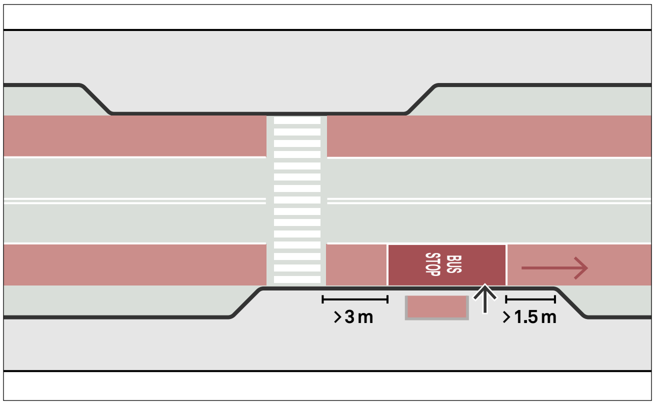
Far-Side Stops

The far-side transit stop is positioned across the intersection, allowing transit to decelerate through the intersection before stopping. Far-side stops minimize conflicts with turning vehicles and may incorporate transit signal priority. Far-side stops are appropriate at intersections with significant delay from traffic congestion, where traffic is heavier on the near side, and at complex intersections with multiphase signals.



Mid-Block Stops

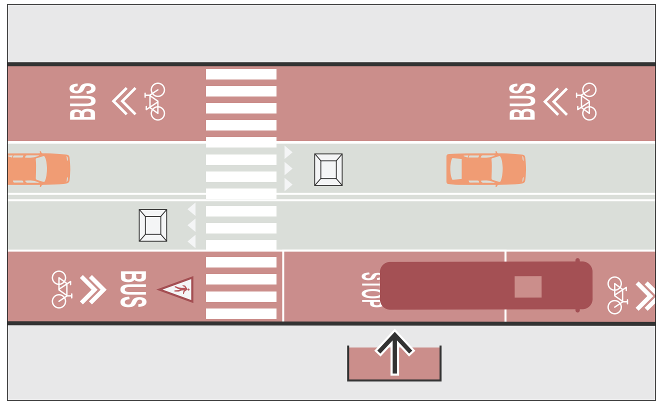
Mid-block stops may be used at sites that generate a high volume of transit passengers or where insufficient space exists at adjacent intersections. Mid-block stops reduce visibility challenges related to turning vehicles and intersecting traffic, but increases walking distance for passengers if no mid-block pedestrian crossings are provided. While designing mid-block stops for high capacity, safe pedestrian crossing should be provided. Curb extensions such as bus bulbs should be provided as extra space for waiting passengers when there is curbside parking.



6.5.6 | Additional Guidance

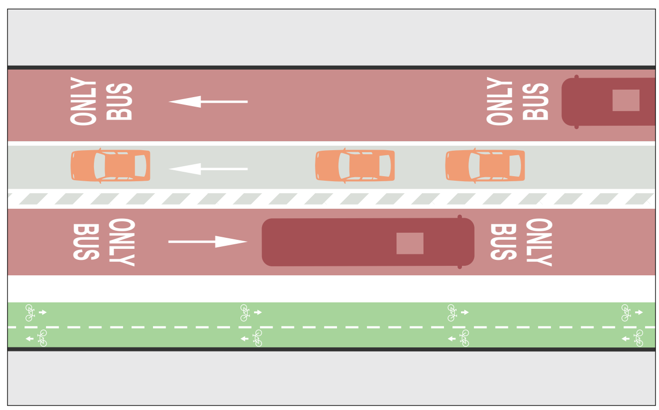
Sharing Transit Lanes with Cycles

Buses and cycles often compete for the same space near the curb. On streets without cycle infrastructure, curbside bus lanes frequently attract cycle traffic, prompting some cities to permit cycles in bus lanes. Shared bus-cycle lanes can safely accommodate both modes, at low speeds with moderate bus headways, where buses are discouraged from passing. Cycles are permitted to pass buses only at stops. Bus lanes should be no more than **4 m** wide. While they are not part of a high-comfort cycle network, bus-cycle lanes can be preferable to mixed traffic. Where space allows, a dedicated facility for cyclists should be provided.



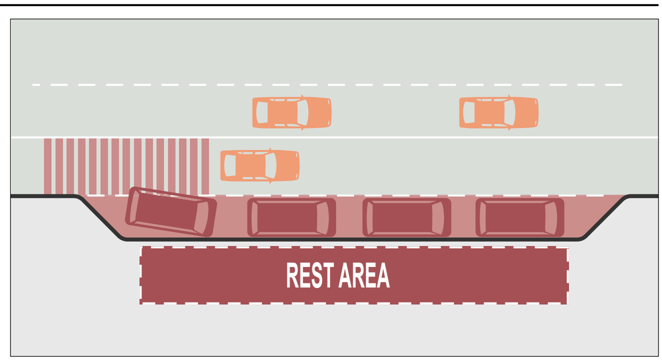
Contraflow Lanes on One-Way Streets

Contraflow bus lanes can increase connectivity and shorten travel times for bus routes. Contraflow bus lanes are typically applied to bus routes to create strategic, efficient connections, though they may be employed along a long corridor. Contraflow lanes can allow more-efficient transit operations where a one-way street network would otherwise complicate transit routing. Transit running in both directions on the same street, instead of using a couplet of nearby parallel one-way streets, can improve legibility of the route for passengers and better serve key destinations. Design contraflow transit lanes as two-way streets, with special consideration for alerting pedestrians to transit potentially coming from an unexpected direction. Good signalization is key to reducing conflicts. Turns across the contraflow lane must be restricted or managed; turn restrictions create an opportunity for a conflict-free cycle track protected by the transit lane. Contraflow lanes should be **3.5–4 m** wide to allow enough buffer between oncoming traffic.



Rest Areas

Rest areas are seating spaces dedicated to transit drivers near designated parking areas or at locations where mini buses or auto-rickshaws are parked. Provide dedicated parking and rest areas to improve the comfort for drivers and to avoid these uses taking space away from other users. Rest areas should be sheltered or shaded according to the local climate. They might be provided on wide sidewalks, curb extensions, or in setbacks and should not obstruct pedestrian clear paths.



6.6 | Designing for Motorists



6.6.1 | Overview

Motorists use automobiles and motorbikes to move around the city. These vehicles can be used as for-hire vehicles (taxis), shared vehicles (car share and car pool), or personal vehicles. While these uses have different curbside needs, they have similar geometric needs and are addressed together in this section.

Traditionally, personal motorized vehicles, and particularly automobiles, are a major consumer of street space. Vehicles occupy space when moving in travel lanes and in on-street parking spots. When street space is unpriced or unrestricted, congestion emerges, increasing travel times and pollution, reducing space for other uses, and negatively impacting livability.

Travel lanes for motorists are often mixed facilities shared by cars, buses, and cycles. They are frequently complemented with curbside parking spaces, curb zone facilities such as parking meters, intersection elements such as stop lines and traffic signals, and wayfinding and speed signs across the corridor for navigation and compliance.

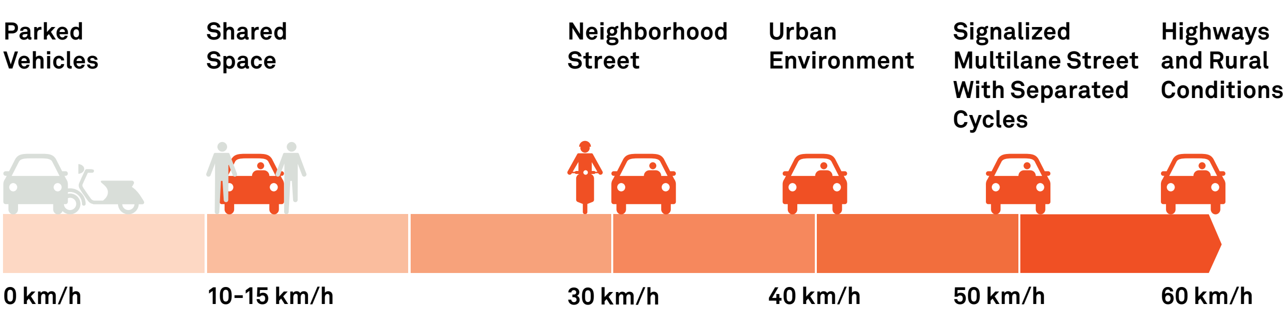
Personal motor vehicles are often restricted on various corridors such as pedestrian zones, transit streets, and at times on shared streets.

When street space is unpriced or unrestricted, congestion emerges, increasing travel times and pollution, and decreasing livability.

Speed

The speed of moving vehicles is directly related to the safety of the street and other users. While cars on highways are capable of higher speeds with relatively lower risk, these capabilities become a liability to occupants and people outside the vehicle in urban settings.

Urban streets should be designed to support a maximum of 40 km/h. In the densest urban areas and when sharing a lane with cycles, speeds should be at or below 30 km/h. When shared with pedestrians, it may be necessary to limit speeds to 15 km/h or less. The grey area on the bar below represents speeds in non-urban areas. *See 9.1: Design Speed.*

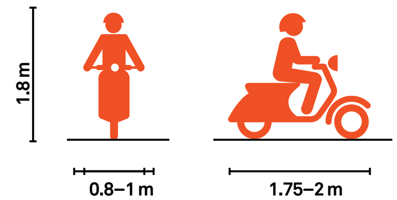


Variations

Vehicle size and fleet characteristics vary around the world, largely in response to street design, parking, regulatory characteristics, and wealth. In many cities, vehicles must frequently navigate narrow or historic street networks or have limited parking availability, encouraging smaller average fleet sizes and the use of motorized two-wheelers. Large cars and light trucks used as personal vehicles are common where urban streets, especially lane widths, are relatively large. Ensure vehicles of all types meet global safety standards to support the safety of vehicle occupants as well as other street users.

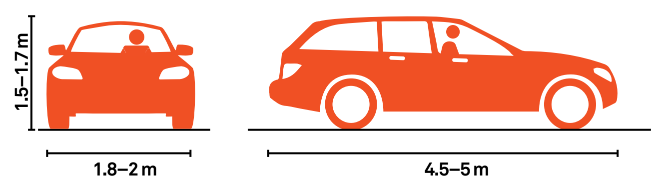
Motorized Two and Three Wheelers

Scales can vary, but dimensions are generally between **1.5–2.3 m** in length and **0.5–1 m** in width. Motor scooters and mopeds are smaller and less powerful than motorcycles and have low top speeds. These are often used as an alternative to cars for reasons of cost and convenience, especially where collective transport is limited.



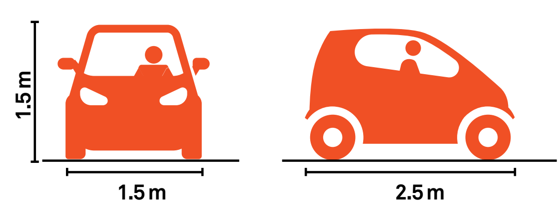
Automobiles

Personal automobiles come in many sizes, depending on type and context. Electric cars have potentially sustainable power sources and are sometimes used in car-share programs that allow access to motor vehicles at lower personal and social impact. Accessible vehicles are specially designed for use by people with disabilities and are especially important where collective transit is not available. Taxis are automobiles used as a for-hire service.



City Cars and Microcars

City cars and microcars are a form of limited-use vehicle, usually 2-seaters with some freight capabilities. These vehicles are often used in car-share systems and have lower parking impacts than full-size cars. They have lower emissions and less skill requirements than motorcycles.



6.6.2 | Motorist Networks

The primary goal of vehicle network design is to provide access to the city with personal motorized vehicles without disrupting other modes or urban life. Urban car trips include on-foot access at either end of the journey as well as time taken for parking. As with transit, the time spent in motion is a small portion of the total travel time. Motor vehicle travel times in urban areas are more affected by intersection wait times and the availability of parking than by top operating speeds. Use pricing for parking and vehicle entry, as well as area-wide traffic metering, to discourage unnecessary vehicle use within the network. ***See 8: Operational and Management Strategies.***

Classifying streets strictly into arterial, connector, and local is misleading because it considers only one user and can lead designers to neglect non-mobility functions and access for all users.

Some of the fundamental tasks related to urban vehicle network management are:

- Determining where and when access is to be provided, and for which vehicle types
- Creating basic network connectivity
- Preventing through traffic from overwhelming city streets
- Limiting the accumulation of automobiles in dense areas

For citywide access by personal motor vehicle, network connectivity is more important than the speed of each street segment. For automobiles, a street classification system should be based on the vehicle operating environment and the possibility of through movement, rather than the intended length of trips.

Grid systems provide connected networks, with frequent intersections allowing traffic management techniques and one-way operation with relatively short diversions. Parallel streets can serve different functions in a grid, and support distinct contexts. In some portions of the network, most streets may serve a through function, diminishing volume on each but spreading impacts around an area. In other areas, it may be advantageous for most streets to be filtered, raising vehicle volumes on the major street but providing a higher-quality environment on other streets.

A strategy of filtered permeability or area-wide metering can be used to prevent all streets from becoming through-streets. Through-moving vehicles can be encouraged to divert from a street at successive nodes, creating good access conditions for motor vehicles without permitting high vehicular volumes in sensitive portions of the street. Using street direction changes and diversions to discourage some through movement, and encouraging the use of less-sensitive routes through wayfinding and lane continuity can allow for the creation of successful neighborhood-scale shared street networks and slow zones.

At the citywide level, networks can be planned to permit surface connectivity between neighborhoods without entering the highest-density areas, discouraging the use of personal motorized vehicles for trips to concentrated destinations that are better served by transit.

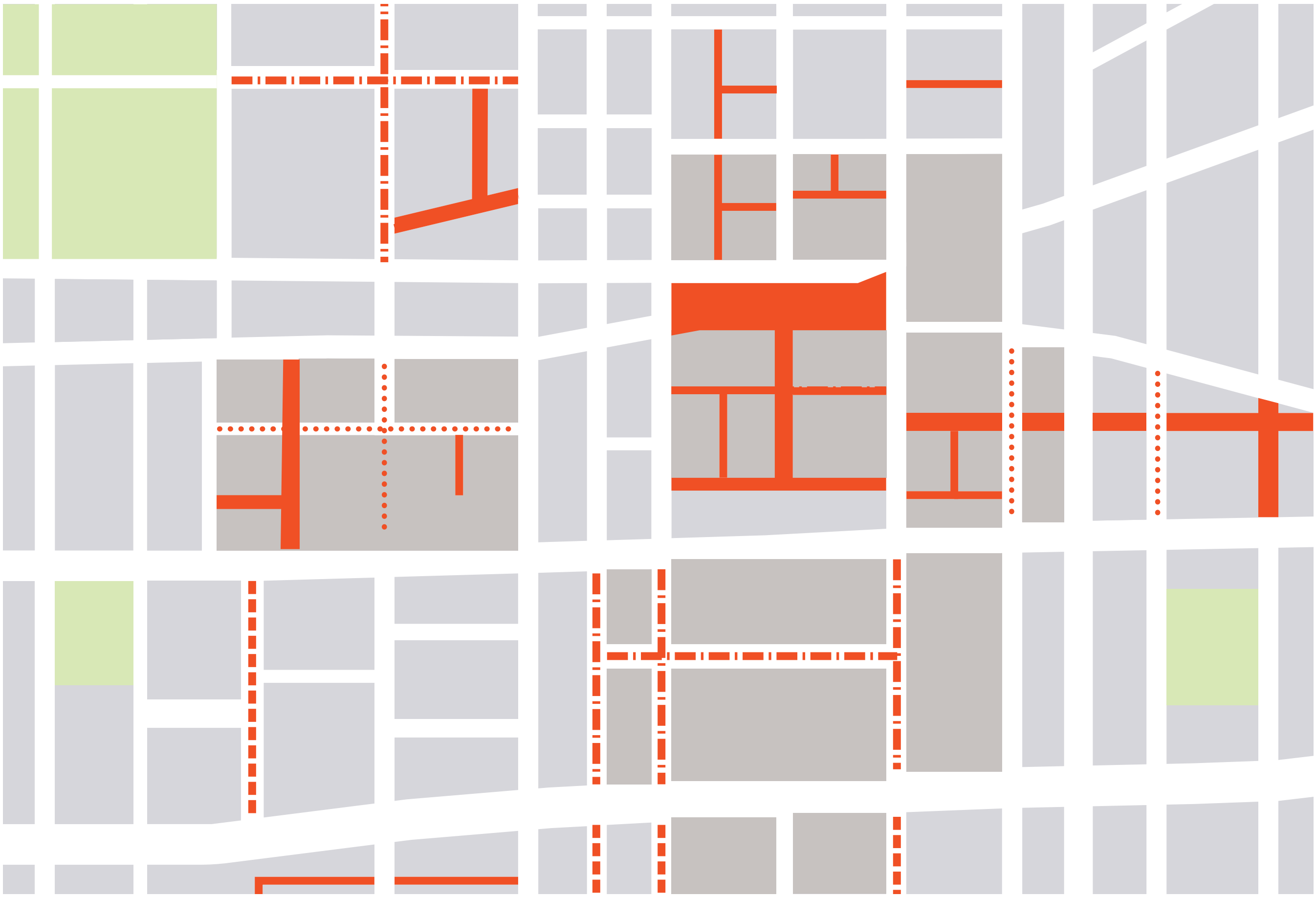
Car-free zones and delivery-only zones in city centers and other destination areas provide large public spaces and have a network-wide effect of reducing car traffic demand. This frees up capacity for freight and for trips that are less well-served by collective transit.

Slow Zones

Neighborhood Slow Zones are community- or city-led programs that reduce the speed limit to lower the risk of traffic crashes. Slow Zones enhance the quality of life for residents by making streets safer and reducing noise and air pollution. Local governments and communities should designate Slow Zones on local residential or neighborhood streets and areas around schools or key destinations. *See 6.6.7: Traffic Calming Strategies.*

Limited Traffic Zones

Limited traffic zones are areas where motorized traffic is restricted and access is allowed only for specific users or vehicles. This might include local residents, people with accessibility permits, environmentally friendly vehicles, loading vehicles, public utility vehicles, police and emergency vehicles, at specific hours, for loading purposes. Access to limited traffic zones may be completely restricted, permitted at certain hours, or permitted with an access fee. Traffic is generally physically restricted by using fixed or retractable bollards. *See 8.8: Volume and Access Management.*



Vehicle Networks: A variety of strategies, including car-free areas, shared spaces, slow zones, and limited traffic zones, is fundamental in order to allow access to the city with personal motorized vehicles without precluding the safety and the mobility of other modes.

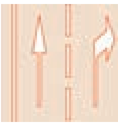
- Car-free areas
- Shared spaces
- Slow zones
- Limited traffic zones

Porto, Portugal. Limited traffic zones defined by bollards.

Copenhagen, Denmark. Slow streets around residential neighborhoods in the city.

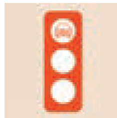
Bandung, Indonesia. Motorized two-wheeler parking.

6.6.3 | Motorist Toolbox



Travel Lanes

Travel lanes are often shared with other street users. Mixed-traffic lanes should not be wider than **3 m**. When travel speeds are 30 km/h or lower, narrower lanes are preferable. On designated truck and bus routes, cities may choose to use wider lanes of up to 3.3 m.



Traffic Signals

Traffic control signals at intersections and mid-block crossings manage traffic flow by avoiding conflicts. They also increase traffic capacity. Signals are a critical tool and can be used to reduce speeds while improving flow when timed to low, urban speeds. *See 8: Operational and Management Strategies.*

Signage

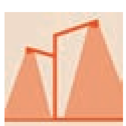
Signage may indicate regulatory information such as speed limit, turn restrictions, or allowable access. Wayfinding signage provides information about upcoming destinations and street names. Signage should not be used as a substitute for geometric design.

Surface and Pavement Markings

Surface markings are used to provide information on required driving behavior. Markings indicate lane divisions and speed limits, and provide direction arrows for through traffic and turning lanes. Use the same markings consistently to communicate quickly and intuitively. Use unique markings to call attention to special conditions.

Stop Bars

Stop bars, located where a stop sign or traffic signal is in effect, should be installed on all but the lowest-volume streets. Marked lines are typically **20 cm** or wider, placed at least **1.5 m** back from the pedestrian crossing, indicating where to stop. The stop bar should be aligned with the stop sign at stop controlled intersections. Where trucks and buses are present, place stop bars at least **3 m** from pedestrian crossings to maintain sightlines between large vehicles operators and pedestrians.

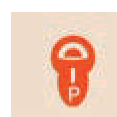


Lighting

Typically provided on a pole or post at the edge of the curb, street lights that are grid-powered should be connected underground. When electricity supply is unreliable, off-grid solar power should be considered. Street lights may be programmed to work only at certain hours of the night, or they may activate automatically using photocells. Coordination with pedestrian-scale lighting is important to ensure a safe environment. *See 7.3.1: Lighting Design Guidance.*

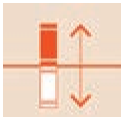
On-Street Parking

On-street parking spaces are mostly curb-side spaces, unless separated by cycle lanes or service lanes, designated for automobile parking. They should not be wider than **2.5 m**, though when shared with city services and freight vehicles, width up to **3 m** is acceptable. Curbside parking spaces need not be continuous and can be interspaced with facilities such as parklets, planting, and cycle share stations.



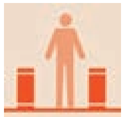
Parking Meters

Parking meters are payment devices for on-street parking, typically located on the edge of the sidewalk, in the buffer zone. They may accept cash, credit cards, or mobile payments, and indicate the length of time authorized for parking. Multi-space parking meters are preferred to reduce sidewalk clutter.



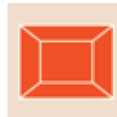
Access Management

Access management strategies may range from policies to physical infrastructure that restrict vehicle access to specific areas of the city. Physical elements include movable or depressible bollards to restrict access at certain hours or for certain vehicles. Regulated passes and reading machines can be installed for residents or special users in particular contexts.



Bollards

Bollards restrict access to certain areas of a street by providing a physical barrier. Often vertical posts, they can be designed in conjunction with planters, lighting, seating, and other street furniture. Use flexible bollards to restrict access as an interim solution and retractable bollards to allow access to car-restricted neighborhoods for authorized vehicles such as emergency vehicles or residents.



Traffic Calming Strategies

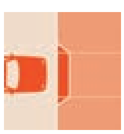
Traffic speeds should be reduced by using a variety of calming techniques that physically alter the roadway. Typical strategies include changing the geometry of the street by implementing pinch-points, chicanes, or speed tables; or changing how people perceive and respond to a street by adding street trees and minimizing building setbacks.

Electric Vehicle Charging Stations

On-street electric charging stations adjacent to parking spaces provide a boost to both private and car-share electric vehicles. These parking spaces should be reserved for electric vehicles and marked accordingly.

Accessible Parking Spaces

Accessible parking spaces should be dispersed through areas where on-street parking is provided. Particularly important in commercial districts and near civic facilities, these spaces should provide clear access to pedestrian curb ramps and sidewalk clear paths. Clear signage and markings should indicate no parking for drivers without permits. These parking spaces should be located as close as possible to the entrances of public and private facilities.



Curb Cuts

Curb cuts for vehicles provide a break in the curb in order to allow access into a driveway. These should be designed to minimize conflicts with pedestrian and cycle lanes and maintain a continuous walking path. Curb cuts limit the number of street trees that can be planted, restrict opportunities for active and engaging ground floors, and are often prohibited or restricted through minimum spacing and maximum width regulation.

Traffic Enforcement Cameras

Also known as road safety cameras, these can be mounted beside or over a roadbed to assist in detecting violations. They are often used for automatic ticketing of drivers who speed, run red lights, travel in bus-only lanes, or for charging entrance to restricted vehicle areas through number plate recognition systems.

6.6.4 | Travel Lanes

Highway lane-width standards, when applied in cities, result in overly wide, undifferentiated lanes that perform poorly at most times of the day, with speeding at off peak times and lane-splitting during peak traffic periods. Reducing lane width to 3 m or less promotes safe driving speeds in an urban environment.

Travel Lane Width

Wide travel lanes have been favored in some places to create a more forgiving environment for drivers, especially in high-speed environments where narrow lanes may feel uncomfortable or increase potential for side-swipe collisions.

Lane widths of less than 3.5 m have been assumed to decrease traffic flow and capacity, a claim that new research refutes.[11]

Lane widths of **3 m** are appropriate in urban areas and have a positive impact on street safety without impacting traffic operations. For designated truck or transit routes, one travel lane of **3.3 m** may be used in each direction. In select cases, narrower travel lanes of **2.7–3 m** can be effective as through lanes in conjunction with a turn lane.[12] Lanes greater than **3 m** are discouraged as they enable unintended speeding and double parking, and consume valuable right-of-way at the expense of other modes.

Restrictive policies that favor the use of wide travel lanes have no place in constrained urban settings, where every centimeter counts. Research has shown that narrower lane widths can effectively manage speeds without decreasing safety, and that wider lanes do not correlate to safer streets.[13] Moreover, wider travel lanes increase exposure and crossing distance for pedestrians.[14] Lane width should be considered within the overall assemblage of the street.

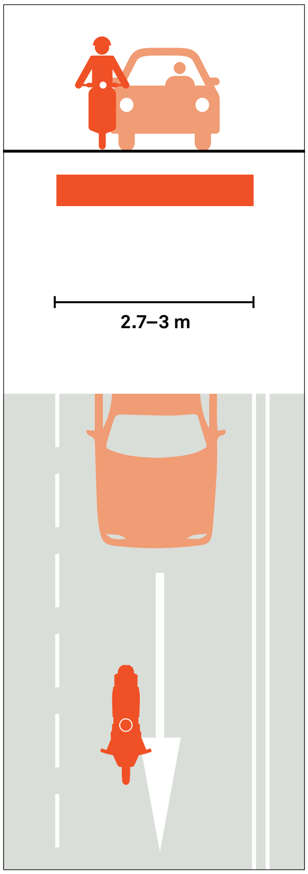
Multilane Roadways

In multi-lane roadways where transit or freight vehicles are present, one wider travel lane may be provided. The wider lane should be the outside lane, curbside or next to parking. Inside lanes should continue to be designed at the minimum possible width at **3 m** or less.

Parking Lane Width

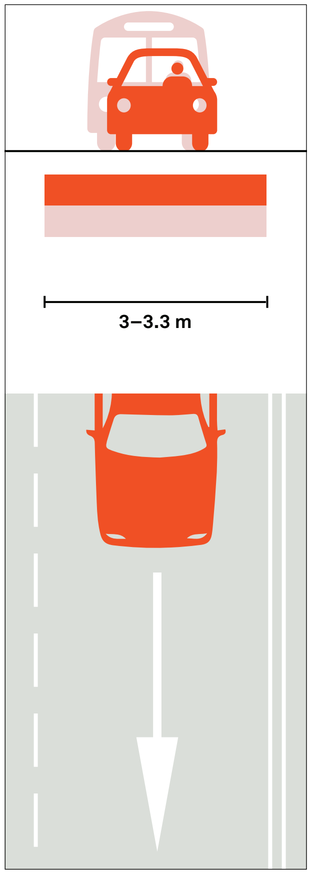
Parking lane widths of **1.8–2.5 m** are recommended. Cities are encouraged to demarcate the parking lane to indicate to drivers how close they are to parked cars.

Geometry



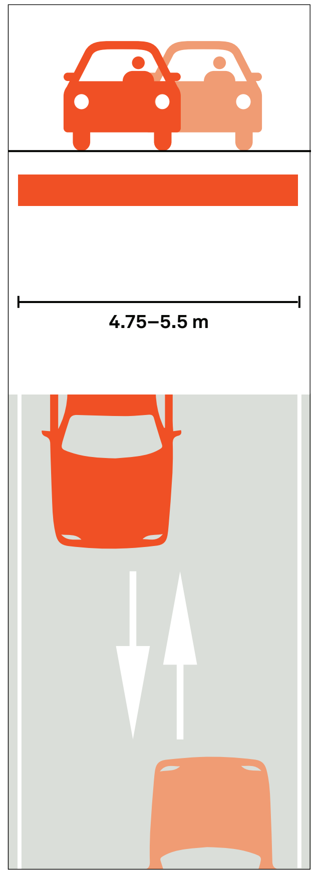
Travel Lanes

The recommended width for through lanes shared by cars, two-wheeled motorized vehicles, and occasional full-size transit vehicles is **3 m**. This width serves all of these vehicles while discouraging high speeds. Lanes that are **2.7 m** wide may be used in streets with speeds of 30 km/h or lower.



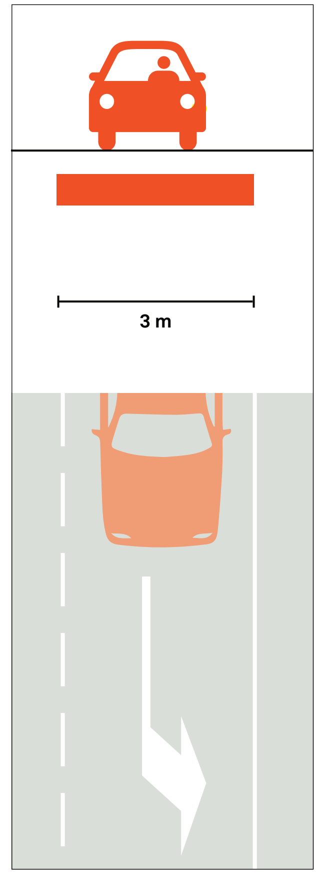
Large Vehicles Lanes

Through lanes of mixed traffic shared with trucks and buses may be **3–3.3 m** wide. Curbside travel lanes may also be **3.3 m** wide. Remnant width should not be added to the lane.



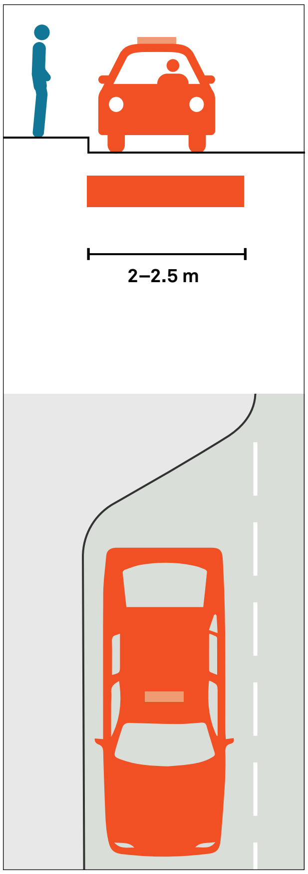
Bidirectional Travel Lane

The recommended width for bidirectional lanes, also known as yield lanes, is **4.75–5.5 m**. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass.



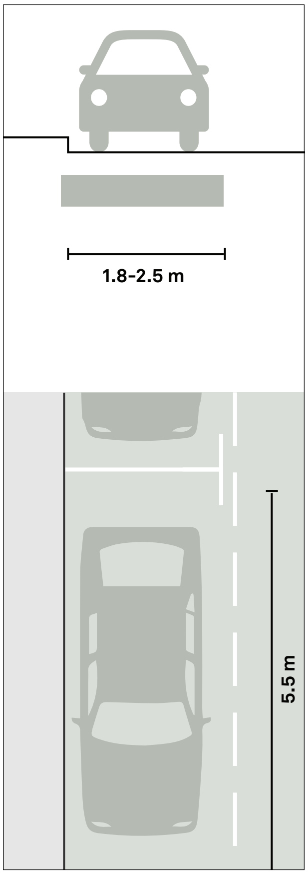
Turning Lanes

The recommended width for turn lanes or pockets is **3 m** or narrower if truck volumes are low. If wider turn radii are needed, channelization, recessed stop bars, or curb extensions are preferable to wide curbside turn lanes. Where larger effective turn radii are needed, such as where transit vehicles or trucks turn, a recessed stop bar may be used on the receiving side. *See 9.2: Design Vehicle and Control Vehicle.*



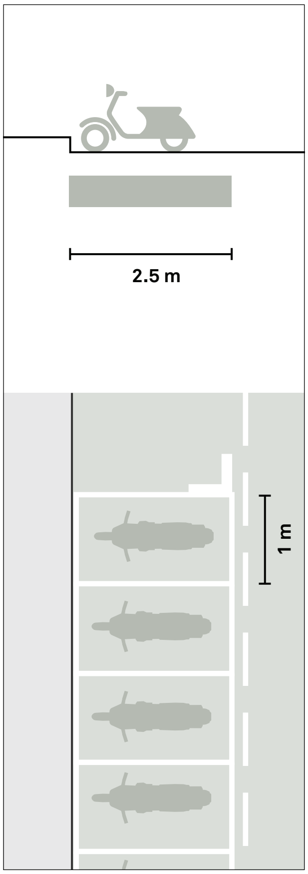
Taxi Stands

Taxi stands or taxi loading zones are lanes where for-hire vehicles can line up to wait for passengers. Taxi stands may be provided on streets near high-capacity locations such as airports, railway stations, and transit hubs.



Parking Lanes: Parallel

Parking lanes should typically be **1.8–2.5 m** wide. On high-volume streets or where transit operates next to a parking lane, a **2.5 m**-wide parking lane is recommended. Parking lanes should always be marked to communicate where to park and accommodate car share vehicles.

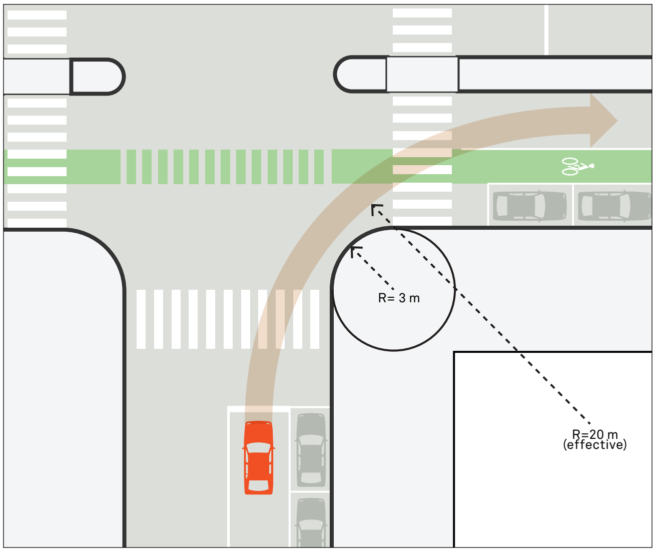


Motorcycle Parking

Parking spaces are recommended to be **2–2.5 m** long and at least **1 m** wide. This type of parking should be provided where the use of motorcycles is common. They have similar dimensions to parallel parking lanes, so they can be provided in conjunction with automobile parking. Providing dedicated spaces for motorcycles allows sidewalks to remain clear and safe for pedestrians.

6.6.5 | Corner Radii

Corner radii directly impact vehicle turning speeds and pedestrian crossing distances. Minimizing the size of a corner radius is critical to creating compact intersections with safe turning speeds. While standard corner radii are 3–5 m, in urban settings, smaller corner radii of 1.5 m are preferred and corner radii exceeding 5 m should be the exception.



Overview

The size of the corner relates directly to the length of the pedestrian crossing. Longer pedestrian crossings take more time to cross, increasing pedestrian exposure to risk and diminishing safety.

A smaller corner radius expands the pedestrian area, allowing for better pedestrian ramp alignment.

The distinction between the corner radius and the effective turning radius is crucial and often overlooked. The corner radius may be a simple or a complex curve and depends primarily on the presence of on-street parking, bike lanes, the number of travel lanes, medians, and traffic control devices. Corner radii are often based on the intersection geometry only and overlook the effective radius. As a result, drivers making a turn on a green signal have little incentive to turn into the nearest receiving lane and routinely turn as wide as possible to maintain travel speeds.

Smaller corner radii reduce turning speed and expand the pedestrian area, creating a safer environments for all users.

Design Guidance

Turning speeds should be limited to 10 km/h or less. Minimizing turning speeds is crucial to pedestrian safety, as corners are where drivers should expect to encounter pedestrians crossing.

Various methods that accommodate large vehicles, while restricting the turning speed of smaller vehicles, may be used to avoid unnecessary widening of the intersection. Minimize effective turning radius where possible by employing one or more of the following techniques:

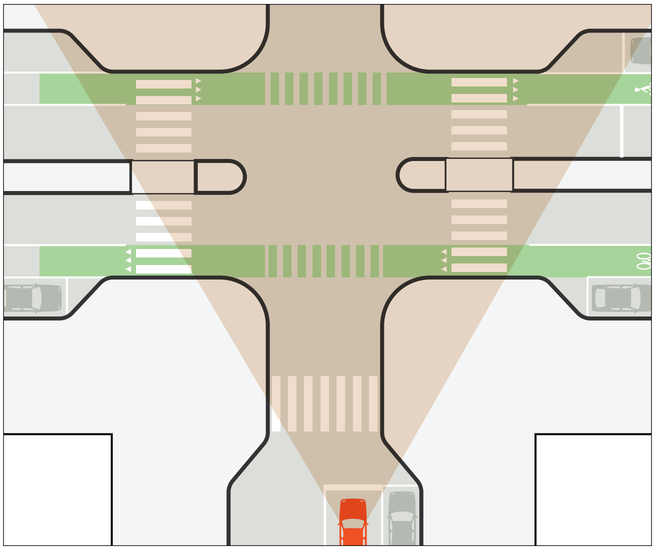
- Select the smallest possible design vehicle.
- Accommodate trucks and buses on designated truck and bus routes.
- Restrict right turns on red so there is no expectation of turning into the nearest receiving lane.
- Require larger vehicles to employ roadway personnel to “spot” vehicles through difficult turns.
- Design so that emergency vehicles may utilize the full area of the intersection for making turns.

In cases where the curb radius of a given intersection has resulted in an unwieldy or unsafe crossing distance, but where funding is not available to reconstruct the curb immediately, a city may delineate the appropriate curb radius using interim materials such as epoxied gravel, planters, and bollards. This should be a temporary option until funding becomes available for a more permanent treatment.

Narrow streets with curbside travel lanes may require larger corner radii because the effective turning radius mirrors the actual corner radius. The same holds true for streets with curb extensions. Streets should not be designed with larger corner radii in anticipation of the entire roadway being used for vehicle traffic at some point in the future.

6.6.6 | Visibility and Sight Distance

Intersection design should facilitate eye contact between street users, ensuring that motorists, cyclists, pedestrians, and transit vehicles intuitively read intersections as shared spaces. Visibility can be achieved through a variety of design strategies, including intersection "daylighting," design for low-speed intersection approaches, and the coordinated placement of traffic control devices, trees, planting, and curbside amenities so as not to impede standard approach, departure, and sight distances.



Overview

Visibility is impacted by the design and operating speed of a roadway. Determining sightlines based on existing or 85th-percentile speeds is not always sufficient. Designers need to proactively lower speeds near conflict points to ensure that sightlines are adequate and movements predictable, rather than widening the intersection or removing sightline obstacles. *See 9.1: Design Speed.*

Sight triangles required for stopping and approach distances are typically based upon ensuring safety at intersections with no controls at any approach. This situation occurs rarely in urban environments, and only at very low-speed, low-volume junctions. At uncontrolled locations where volume or speed present safety concerns, add traffic controls or traffic calming devices on the intersection approach.

In urban areas, corners frequently serve as a gathering place for people and businesses, as well as being the locations of bus stops, cycle parking, and other elements. Design should facilitate eye contact between these users, rather than focus on the creation of clear sightlines for moving traffic.

Wide corners with large sight triangles may create visibility, but, in turn, may cause cars to speed through the intersection, losing the peripheral vision they might have retained at a slower and more cautious speed.

Fixed objects, such as trees, buildings, signs, and street furniture, in the roadway or on the sidewalk may be deemed to obstruct sightlines for vehicles. These objects should not be removed without prior consideration of alternate safety mitigation measures, such as reduction in traffic speeds, curb extension or geometric design, or the use of additional warning signage.

Sightline standards for intersections should be determined using target speeds, rather than 85th-percentile design speeds.

Design Guidance

Daylight intersections by removing parking within **6–8 m** of the intersection.

Site street trees at a minimum of **3 m** from the intersection, aligning the street tree on the near side of the intersection with the adjacent building corner. Street trees should be sited **0.8 m** from the curb return and **2.5 m** from the nearest stop sign.

Lighting is crucial to the visibility of pedestrians, cyclists, and approaching vehicles. Major intersections and pedestrian safety islands should be adequately lit with pedestrian-scaled lights to ensure visibility. In-pavement flashing lights can enhance crossing visibility at night, but should be reinforced by well-maintained retroreflective markings. *See 7.3.1: Lighting Design Guidance.*

In determining the sight distance triangle for a given intersection, use the target speed, rather than the design speed, for that intersection.

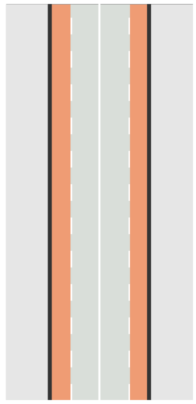
Traffic control devices must be unobstructed in the intersection and shall be free of tree cover or visual clutter.

Additional signage may be provided to enhance visibility at intersections, but should not replace geometric design strategies.

6.6.7 | Traffic Calming Strategies

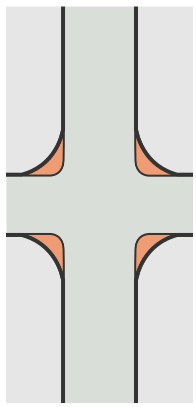
Lane Narrowing

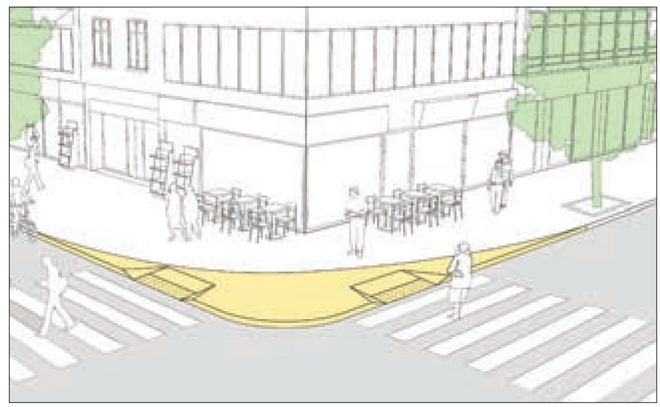
Narrow lanes reduce speeds and minimize crashes on city streets by way of reducing the right-of-way and making drivers wary of traffic and adjacent users. Use the additional space for pedestrian space, cycle facilities, or green infrastructure. *See 6.3.7: Sidewalk Extensions and 8.7: Speed Management*.



Corner Radii

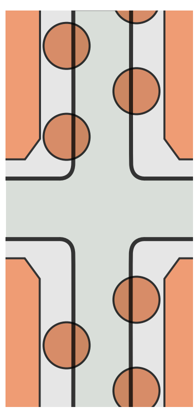
Narrowing corner radii reduce vehicle turning speeds as well as pedestrian crossing distances. Minimizing the size of a corner radius is critical to creating safe and compact intersections. *See 6.6.5: Corner Radii*.





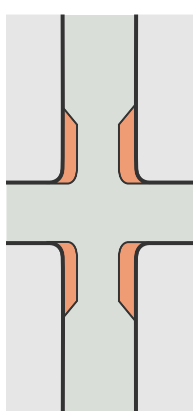
Buildings and Trees

Buildings at the right-of-way with articulated facades and windows indicate that a street is in an urban environment, not a highway. *See 5: Designing Streets for Place*.



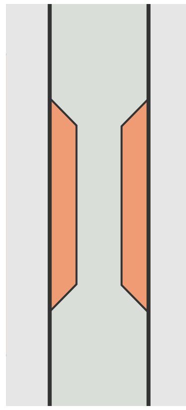
Gateway Treatments

Gateway treatments alert drivers that they are entering a slower area. This treatment may include signage, entry portals, speed tables, raised crossings, and curb extensions.



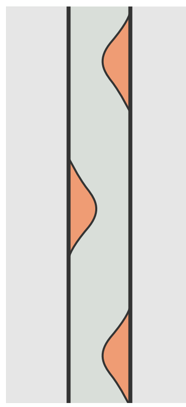
Pinchpoints

Pinchpoints narrow the roadway at a mid-block point. They can be combined with speed tables to create high-quality pedestrian crossings. They can also be used on low-volume, two-way streets to require facing motorists to yield to one another. *See 6.3.7: Sidewalk Extensions*.



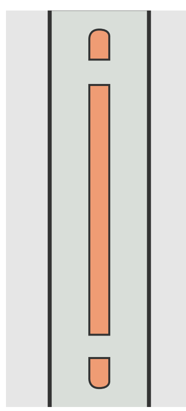
Chicanes and Lane Shifts

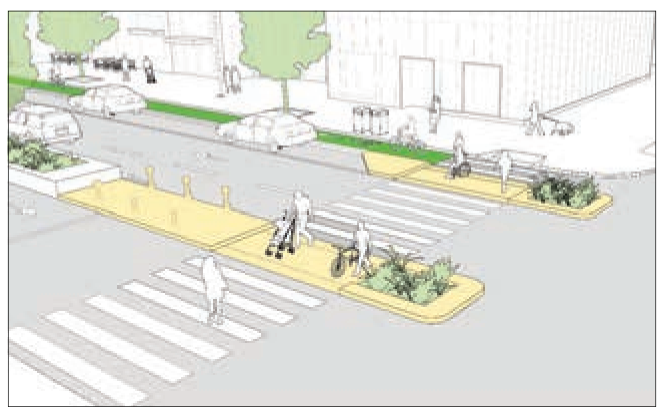
Chicanes and lane shifts use alternating parking, curb extensions, or edge islands to form an S-shaped path of travel which lowers vehicle speeds. *See 6.3.7: Sidewalk Extensions*.



Medians and Refuge Islands

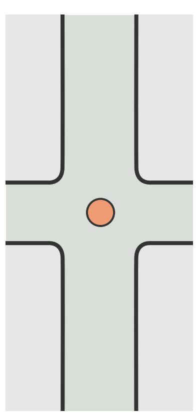
Raised center medians and pedestrian refuge islands can be used to reduce lane width for vehicles, even on relatively narrow streets. They can also be used to organize traffic at intersections or to block access at strategic points. *See 6.3.6: Pedestrian Refuges*.

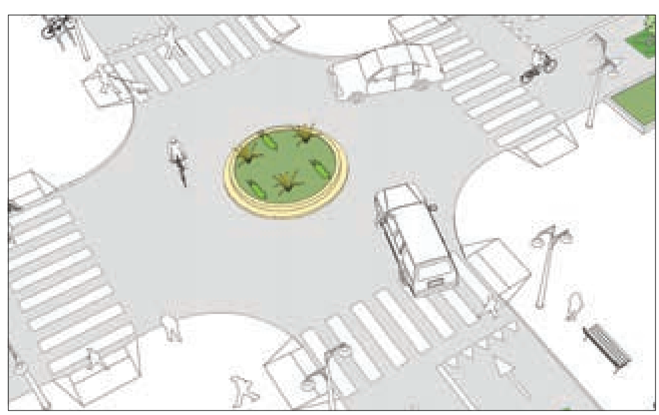




Mini Roundabouts

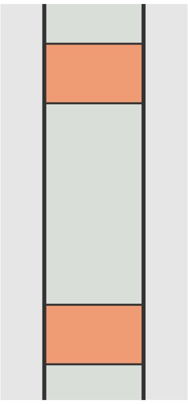
Mini roundabouts are round islands at intersections that serve to both reduce speeds and organize traffic, routing vehicles around the island rather than directly across the intersection. *See 11.4: Mini Roundabout*.

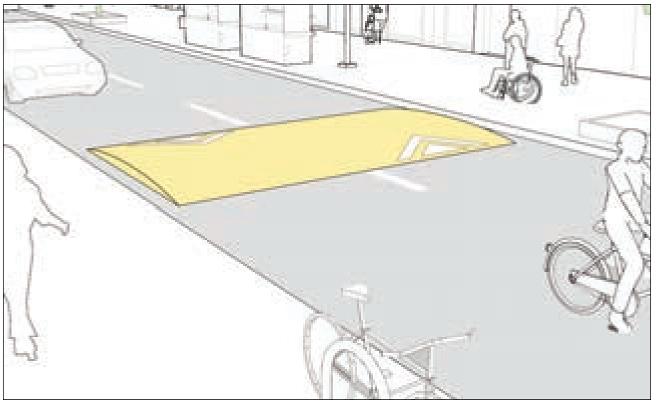




Speed Humps

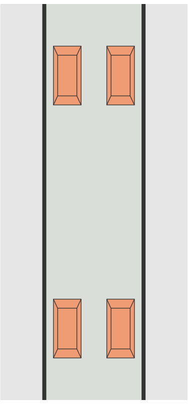
Speed humps are formed by raising sections of the road in a sinusoidal shape, typically **10–15 cm** high and **4–6 m** long. The dimensions can be tailored to match the target speed of the street. They are typically constructed of the same material as the roadway, but can be of different materials.

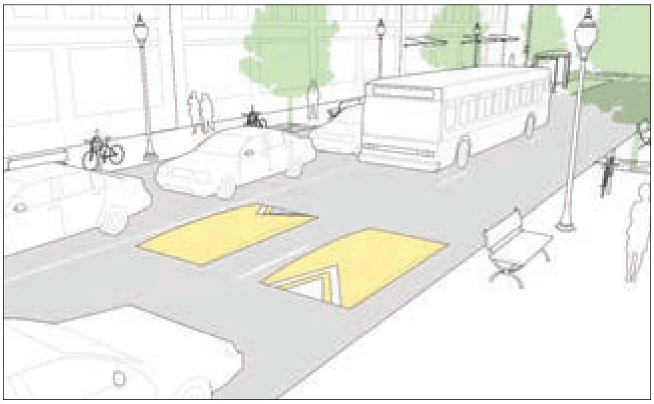




Speed Cushions

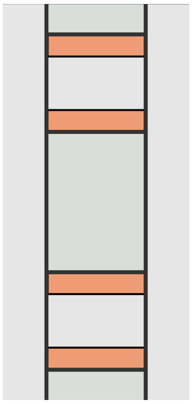
Speed cushions are similar to speed humps, but have wheel cut-out openings to allow large vehicles like buses to pass unaffected while reducing car speeds.





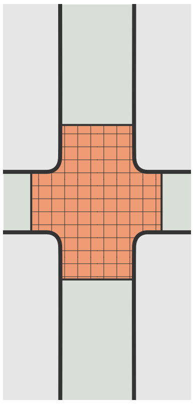
Speed Tables

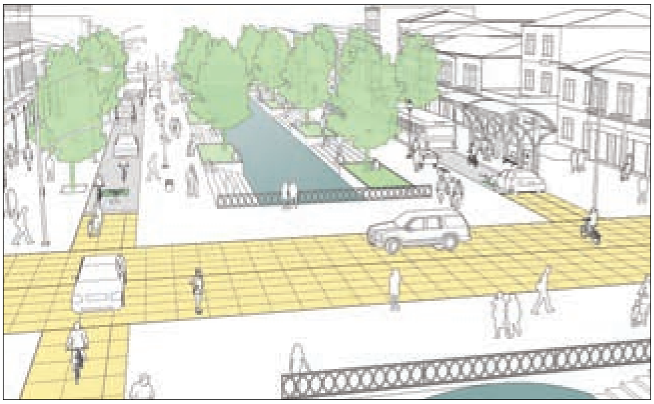
Speed tables are similar to speed humps, but have a flat top, typically **6–9 m** long. When speed tables are combined with pedestrian crossings, at the intersection or mid-block, they are called raised crossings. *See 6.3.5: Pedestrian Crossings.*



Pavement Materials and Appearance

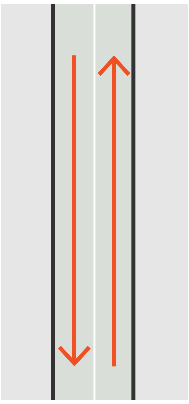
Pavement appearance can be altered through unique treatments that add visual interest, such as colored or pattern-stamped asphalt, concrete, or concrete pavers, which can be used to make other traffic calming techniques more noticeable to drivers. Pedestrian crossings and intersections can be painted to highlight crossing areas.

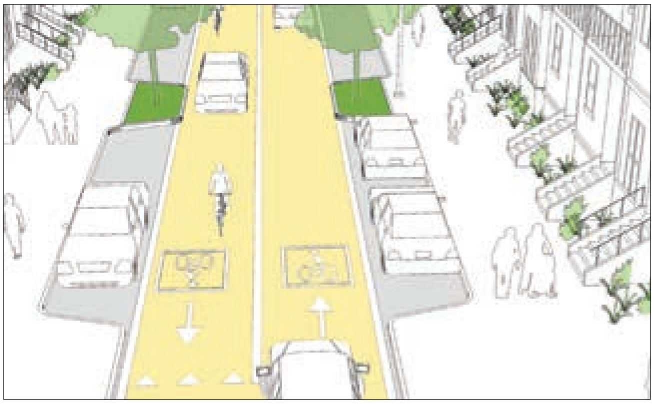




Two-Way Streets

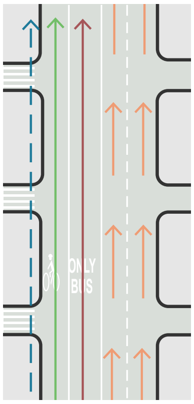
Two-way streets, especially those with narrower profiles, encourage motorists to be more cautious and wary of oncoming traffic. *See 10.6.2: Central Two-Way Streets.*





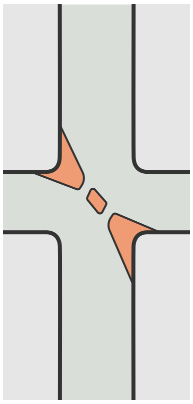
Signal Progression

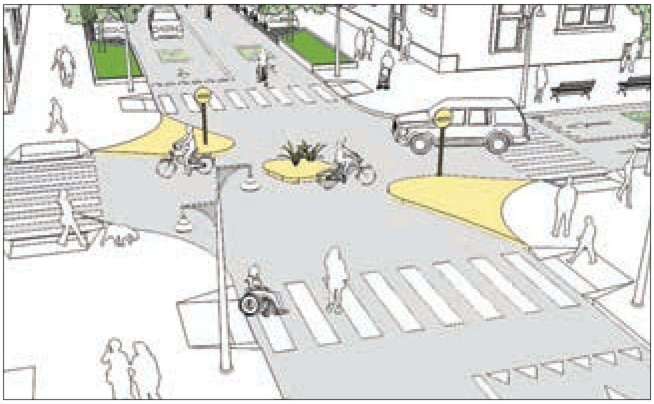
Signals timed to cycle- and transit-friendly speeds can reduce motorists' incentive to speed and can create lower and safer speeds along a corridor. *See 8.7: Speed Management and 8.8: Signs and Signals.*



Diverters

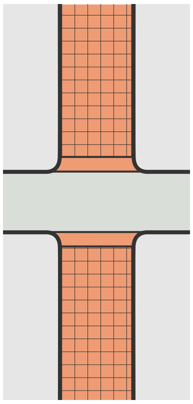
Diverters and other volume management strategies, such as restricted movement and restricted access strategies, help in reducing motor vehicle volumes and speeds. Reduced traffic volumes significantly impact cyclist comfort. *See 8.5: Volume and Access Management.*





Shared Streets

By removing the physical distinctions between pedestrian, cycle, and vehicular spaces, shared street treatments force all users to share the street, increasing awareness and reducing motor vehicle speeds. *See 10.4: Shared Streets.*



6.7 | Designing for Freight and Service Operators

6.7.1 | Overview

A significant amount of traffic on urban streets is generated by the transportation and delivery of goods to local stores, factories, hotels, and other businesses. These vehicles are larger than regular cars and require dedicated space in order to load and unload their goods.

While the efficient, reliable movement of goods is critical for the functioning of a city, it must be carefully balanced with other uses and needs.

Freight vehicles often require larger operating and curb space. They may be channeled to designated truck routes and corridors or directed to remote freight distribution centers.

Design travel lanes and intersections assuming large freight vehicles are infrequent users to minimize the impact on other street users.

Strategically locate access roads and truck routes so that the impact on local neighborhoods can be minimized. Encourage cleaner freight vehicles to reduce carbon emissions and provide buffers for noise and air quality alongside truck routes adjacent to residential areas.

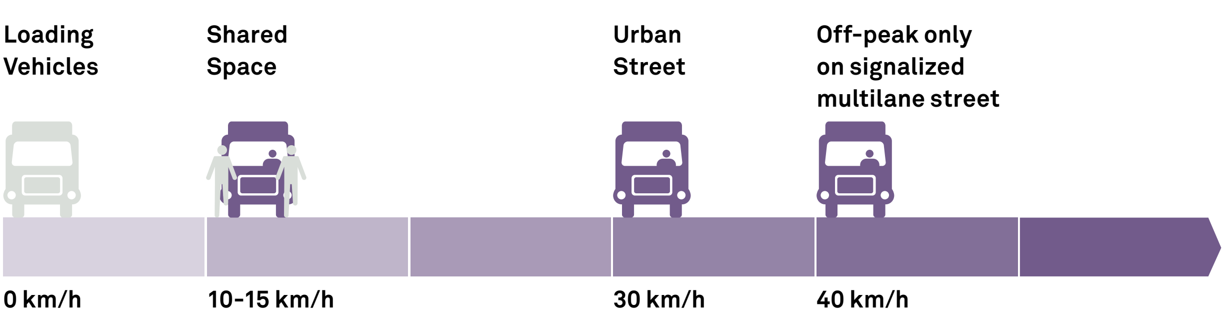
Provide space for hand and cart movement in dense urban areas. Limit curb cuts and loading bays along corridors with heavy pedestrian flows and commercial activity. Work with local businesses and companies to understand specific needs while developing a citywide strategy.

Operating hours for freight activities and city services can be restricted to early mornings or late evenings to avoid conflict with daytime traffic and sustainable mobility modes.

Speed

Because of their mass, large vehicles and trucks speeds should be limited to 30 km/h in urban streets and never exceed 40 km/h. Urban streets should be designed to support a maximum of 40 km/h and turning radii that allow slow turns. *See 6.6.5: Corner Radii.*

Where small commercial vehicles and light trucks share the street with pedestrians, speeds should not exceed 10–15 km/h. *See 9: Design Controls.*

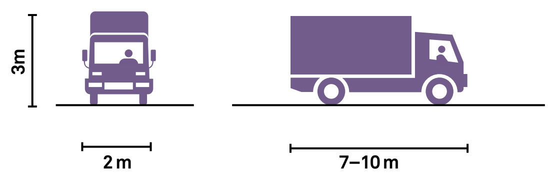


Variations

Vehicles for people delivering goods can range from large trucks and utility vehicles to hand carts and push carts for local distribution. City service vehicles vary drastically depending on context and include fire trucks, waste collection, and street cleaning vehicles. City streets should not be designed to accommodate large trucks on most streets. Where large trucks must be accommodated, design streets to allow access of multiple travel lanes to fit vehicle turning radii. Only cab-over trucks (flat nose) and low-cab trucks should be allowed in urban streets due to their increased visibility and safety.

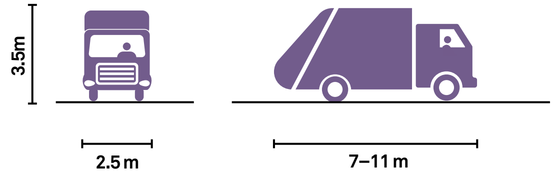
Commercial Vehicles and Light Trucks

These trucks are generally used for carrying goods from ex-urbanized logistic centers to the city. They are bigger in scale compared to motorized personal vehicles but do not require wider corner radii or bigger lanes.



City Service Trucks and Emergency Vehicles

Dimensions of city services vehicles such as garbage trucks as well as emergency vehicles should be adapted to the local context and should be contained as much as possible.



Large Trucks in Designated Truck Routes

Large trucks can use the full intersection (invade the opposite lanes) while performing turns in signalized intersections on designated streets. That way, the curb radius can be kept as small as possible.

6.7.2 | Freight Networks

Street networks must allow for an overlapping set of functions that serve multiple users, but not every street must be designed for large vehicles moving goods through the city. Facilitating reliable delivery and freight movement is essential to economic growth, but it must be accommodated while managing congestion and without sacrificing vibrant streets.

Creating a network to accommodate freight vehicles can increase efficiency while mitigating air and noise pollution. Design local streets for smaller vehicles and infrequent access by large trucks.

Access Routes
Large vehicles delivering goods typically feed in from access points to regional highways. Exposure to emissions and noise pollution from large volumes of truck traffic has been tied to public health challenges such as high asthma rates and increased stress levels. These routes should be planned to avoid residential neighborhoods and areas with heavy pedestrian and cycle volumes.

Distribution Networks
Many commercial locations in urban areas require frequent delivery and pick-up services. These areas present conflicts between high pedestrian volumes and large delivery trucks. Designate urban areas where goods may be transferred from large vehicles to smaller vehicles appropriate for the scale of city streets.

Limited Access
Limit access for commercial delivery to off-peak or nighttime hours, when streets are less busy. Avoid areas with heavy nighttime pedestrian activity.

Loading Zones
Provide dedicated loading bays to prevent delivery vehicles from blocking sidewalks or cycle lanes. Loading zones should be located on each block where deliveries will be made, and should be time- or permit-restricted.

Minimizing Conflict
Large vehicles present a safety challenge for vulnerable users such as cyclists and pedestrians, particularly seniors, children, and people with disabilities. Speeds of large vehicles should be kept below 30 km/h in urban areas. Limit turns in high pedestrian areas to minimize conflict, and avoid sharing cycle routes with truck routes where possible.

Safety is fundamental to determine how large vehicles should move through a street network. Streets should be designed for the most vulnerable user rather than the largest possible vehicle.

Street Cleaning Vehicles
Maintaining clean streets is an important consideration in neighborhood health, pride, and stewardship. Regular street sweeping can also reduce pollutants and debris entering the watershed. Cleaning-truck dimensions are important, but vehicle sizes should not drive street design. Where separated cycle tracks cannot be serviced by standard vehicles, investing in smaller alternatives is highly recommended.

Fire Trucks and Emergency Vehicles
Large vehicles can access dedicated transit lanes in congested areas and perform turning radii that include multiple travel lanes. Where fire hydrants are provided, ensure appropriate clear space for access.

Oversized Vehicles
Access for oversized vehicles carrying large items can be provided on certain routes. Assume projection over multiple travel lanes, low street furniture, and medians given the infrequency of these types of loads.

Freight Networks: Urban streets should provide safe, efficient, and environmentally sustainable networks for moving goods and providing city services. Chosen routes for truck access should minimize impacts to local residents. Street design should reduce conflicts between large vehicles. Restricted delivery times can minimize congestion and balance curb access for loading with other street uses.

Istanbul, Turkey. Limited access areas allow only some vehicles to enter certain zones.

São Paulo, Brazil. Shared streets with loading zones.

Stockholm, Sweden. Signage indicating loading zones and delivery hours.

6.7.3 | Freight Toolbox

Signage

Designated routes for trucks and large vehicles should be clearly marked to minimize undesirable traffic on neighborhood streets. Signage may include weight limits and height and width restrictions.

Dedicated Parking

Dedicated parking spaces for large vehicles avoid conflicts with other users. Durable materials may be selected to support heavy loads.

Turning Lanes

On wide streets, central lanes or medians can operate as turning lanes for large vehicles. Where large vehicles turn on or off smaller streets, greater minimum radii may necessitate use of both lanes. Recessed stop bars or daylighting intersections can ease difficult turns while maintaining clear visibility for all users.

Retractable or Removable Bollards

When loading vehicles and city services require access to areas that restrict regular vehicular traffic, retractable or removable bollards should be installed to facilitate access.

Curb Cuts

Curb cuts that allow large vehicles to access loading bays should be carefully coordinated with other uses and should not diminish universal accessibility. Regulate minimum spacing between multiple curb cuts and limit their overall width to minimize the impact of blank garage doors on a streetscape. Balance loading needs with active ground floors, trees, and other uses that support a bustling street. Restrict curb cuts on streets with high pedestrian flows and designate certain streets as service corridors.

Speed Cushions and Tables

Speed cushions and tables can assist in calming truck traffic. On narrow streets, speed cushions provide a short grade increase, similar to a speed table, without interacting with the wider wheel base of buses and emergency vehicles.

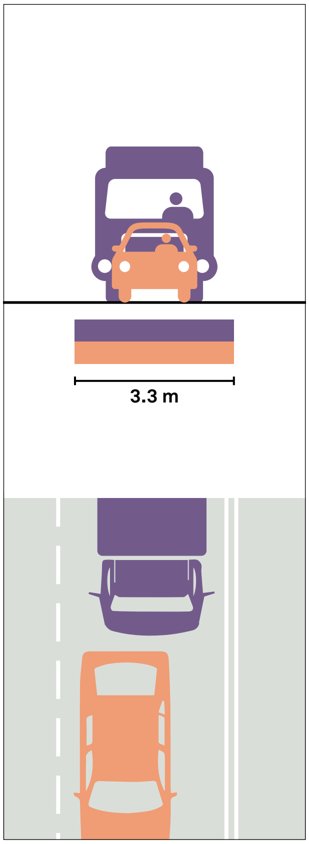
Paving Materials

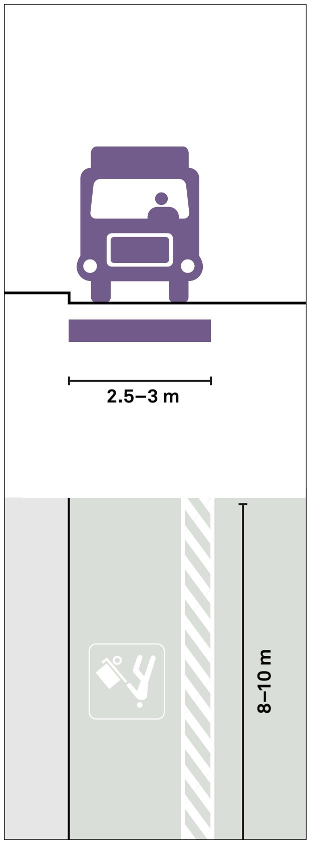
Large vehicles apply increased force on the street, especially when starting, stopping, and turning. For designated loading zones, it is preferable to employ durable paving materials such as concrete pads or block pavers, which can withstand greater forces without buckling than can asphalt.

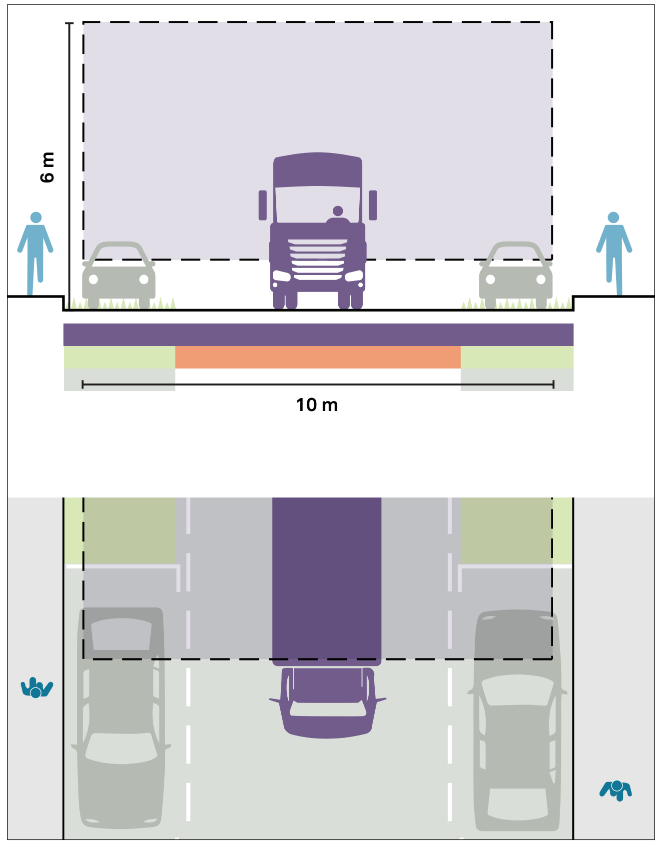
Time Restrictions

Freight vehicle access to dense urban areas should be restricted to off-peak periods such as early mornings or late evenings. Time restrictions limit conflicts with other street users, increase safety, reduce congestion, and ultimately facilitate better delivery operations and increased efficiency.

6.7.4 | Geometry







Travel Lanes

The recommended width for travel lanes on routes that allow trucks and large vehicles is **3.3 m**, and any allowable truck routes or restrictions should be clearly marked. Use freight vehicles as the design vehicle to set widths and corner radii only on primary freight corridors. On smaller local routes where freight access is needed, use smaller vehicles as the control vehicle.

Loading Bays

Loading bays facilitate the efficient pick-up and drop-off of goods to and from local businesses. These should be located away from intersections to reduce conflicts and in areas where their services will not block sidewalks or cycle lanes. Loading bays should be strategically located to complement other urban street activities, and their use can be limited to certain times. Time restrictions should apply in high-volume pedestrian areas.

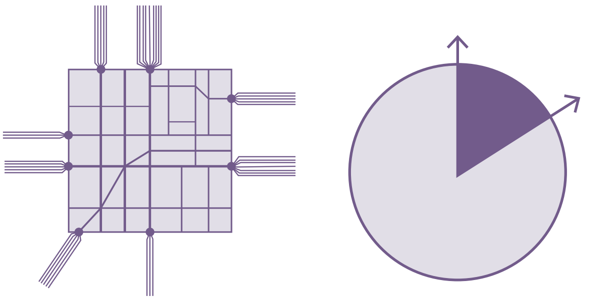
Oversized Lanes

Routes that allow oversized vehicles carrying wide loads, such as prefabricated materials or large construction machinery, should be able to accommodate loads that fit within an envelope of **10 m** wide and **6 m** high. These should be strategically located to allow transfer points for goods to narrower contexts, should be limited to off-peak hours, and assume projection over low streetscape elements such as planters and curb extensions to achieve required clear paths.

6.7.5 | Freight Management and Safety

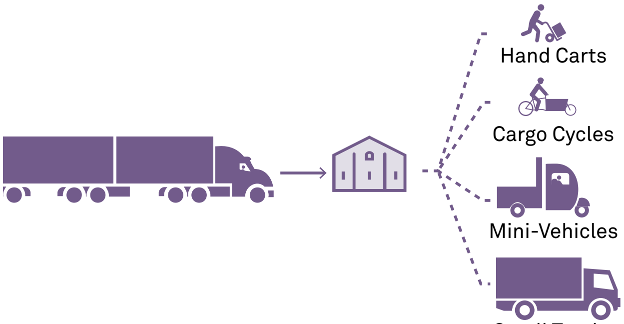
Strategic Planning

Cities may develop comprehensive plans for managing freight and increasing efficiency while reducing impacts on dense urban areas. Citywide plans should include time restrictions to limit when loading activities are permitted. Comprehensive mobility plans should identify priority truck routes for local access, regional throughput, oversize access, and route restrictions. Analyze how loading space is provided at the block level and consider regional tolling or congestion pricing strategies.



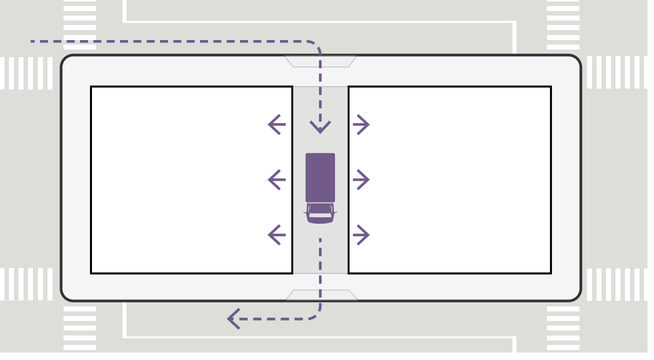
Consolidation and Distribution Centers

Around the perimeter of dense urban centers, warehouse facilities can consolidate incoming freight to be delivered on smaller vehicles. These range from small cargo vans to cargo cycles, and sometimes cargo boats. Consolidation centers alleviate congestion, reduce risk of collisions, and support the use of low-emission vehicles.



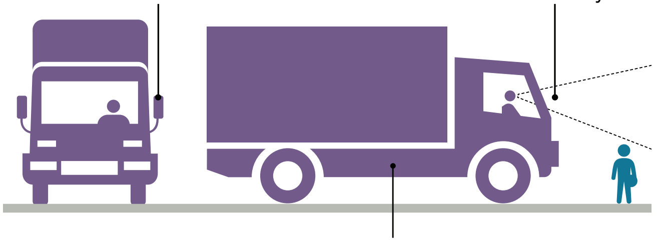
Service Streets and Alleyways

Some cities already have an existing network of alleys and small service roads or driveways. Relocating freight loading to alleyways and service roads allow for more direct access and reduces congestion. Capacity and access must be thoughtfully designed, incorporating potential vehicle sizes and frequencies and allowing width and radii to serve large vehicles at very low speeds. Incorporate raised crossings at gateways to preserve a comfortable pedestrian environment.



Safe Vehicle Design

Freight vehicles, especially large trucks, traveling on urban streets should integrate safety features such as side guards and crossover mirrors. These features mitigate the risk of collision between large freight vehicles turning and pedestrians or cyclists. Pedestrian and cyclist fatality rates in the UK were reduced by 20% and 61%, respectively, after the introduction of policies requiring trucks to be equipped with side guards. Only cab-over or low-cab forward trucks should be allowed in dense urban areas, because of their proven increased safety and improved sightlines.



JOINT DELIVERY SYSTEM SERVING MOTOMACHI AREA, YOKOHAMA, JAPAN

To better coordinate loading and unloading activities in a bustling commercial district in Yokohama, business owners collaborated with the city and the local Shopping Street Association to develop a joint delivery system, addressing concerns on congestion, streetscape quality, and carbon emissions. Without any subsidy from the municipality, businesses came together to develop a pilot program that collects, sorts, and delivers 85% of freight from 500 shops and 850 private homes in the district. The system enabled the reduction of delivery vehicles by 50% in the district and the replacement of diesel vehicles by CNG vehicles to reduce emissions.


Yokohama, Japan

NON-MOTORIZED FREIGHT TRANSPORT NEW DELHI, INDIA

In New Delhi, India, cycle rickshaws are widely used for passenger movement, but are often under-utilized for the movement of goods. However, non-motorized freight movement is becoming legitimized for its economic and space benefits. Motorized vehicles pose a much higher risk to the safety of other road users and create far more emissions. Planners and researchers have taken special interest in accommodating non-motorized freight vehicles in separated street facilities to increase safety, reduce environmental impact, and increase the mobility of cargo.


New Delhi, India

THE FOUR Rs OF FREIGHT DELIVERY LONDON, UNITED KINGDOM

In an effort to address concerns about freight movement and especially the safety of vulnerable road users, Transport for London (TfL) convened a large stakeholder group in 2011 at a Freight Forum to develop and discuss strategies to improve deliveries and large-vehicle safety. TfL released the Four Rs to encourage new strategies: Reduce (making fewer, larger shipments), Re-Time (shifting to nighttime or off-peak deliveries), Re-Route (modifying truck routes, order of deliveries, or depots used to reduce mileage), and Revise Mode (walking or cycling the last mile of deliveries). As a result, during the 2012 Olympics, the city saw a 20% drop in daytime deliveries and a 10% reduction in freight activity by coordinated stockpiling and consolidation of goods.


London, United Kingdom

DISTRIBUTION CENTERS AND CONTEXT-APPROPRIATE FREIGHT VEHICLES, UTRECHT, THE NETHERLANDS

The city of Utrecht serves an increasingly vital freight function within the Netherlands. In response to freight activity causing center city congestion and damage to the medieval street infrastructure, the city initiated a broad effort to reduce congestion and emissions, and increase efficiency in freight movement. Working with private sector stakeholders, the city opened distribution centers outside the city center, where private companies can deliver to or contract for last-mile deliveries into the urban core. The city helped enable innovative freight delivery vehicles using electric boats and cargo hoppers, small electric vehicles that can tow multiple trailers and maneuver easily through narrow city streets.


Utrecht, The Netherlands

6.8 | Designing for People Doing Business



6.8.1 | Overview

Many people use the street to conduct daily business. Their front doors line the street edge; their goods and services extend out onto the sidewalks; they run stalls within the street or push carts throughout the city. These people play a key role in shaping vibrant and dynamic streets.

Often mobile in nature, but sometimes fixed, on-street commercial activities are part of every large city, responding to demand for goods and services that is highly specific and varies with time and location. Street vendors, kiosk owners, fruit stalls, food trucks, and the extension of commercial establishments provide convenient services to commuters, pedestrians, and nearby residents. Spaces for business activities should be incorporated into the design of the street.

Where demand is likely to exist—in locations such as central markets, tourist attractions, and transit stations—include dedicated spaces on expanded sidewalks or in parking lanes.

These uses can activate otherwise blank building edges and, when situated in a parking lane, provide a welcome buffer between pedestrians and adjacent moving traffic.

Commerce is part of every city, and streets should be designed to accommodate formal and informal on-street commercial activity.

Accommodating commercial activity should balance the various users in a given location and always support a safe and vibrant street environment. Considerations should include:

- Siting and location with regard to local context.
- Critical distances to maintain clear pedestrian paths and crossings.
- Use of parking lanes or furniture zones along the sidewalk.
- Scale and design of any fixed or mobile structures.
- Permitting processes and local enforcement.
- Times and seasons of use.
- Clear communication of regulations.
- Ongoing maintenance including regular cleaning and waste management.
- Health and safety standards for activities involving food and beverages.
- Access to utilities such as power and water

Variations

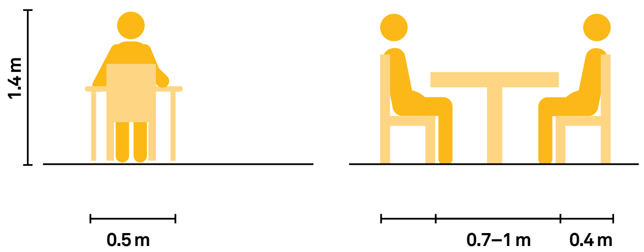
Commercial uses provide vitality and activity within the street, support local economies, and make streets more livable and attractive to for all users. Many types of commercial activities provide amenities and add character to the street, from sidewalk cafés, to market stalls, food trucks, and push carts.

Milan, Italy. Sidewalk cafés animate a pedestrian-oriented street in the historic part of the city.

Sidewalk Cafés

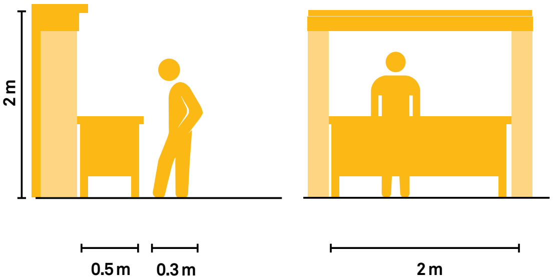
Sidewalk cafés play an important role in animating streets and creating neighborhood destinations. While narrow seating areas can be provided in as little as **1 m** widths, larger seating areas require deeper strips of **2–4 m.**

The area reserved should not interfere with the pedestrian clear path, allowing a minimum width of **2.4 –3 m** according to pedestrian volumes. Movable chairs and small tables provide more flexibility and can be easily removed to ensure wheelchair accessibility. Use furniture and planters to clearly demarcate the strip and make it more detectable for visually impaired users. Design sidewalk cafés to be universally accessible.



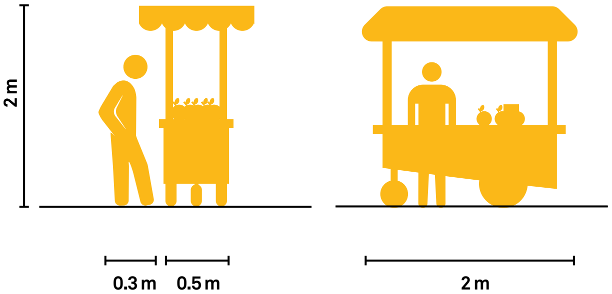
Storefront Spillovers and Stalls

Ground floor businesses often want to extend their storefronts by installing display areas adjacent to their facades, attracting visitors or increasing attention. These areas should only exceed the length of the storefront, unless covering blank walls or fences, and be at most **1.5–2 m** wide. Maintain the sidewalks clear path and universal accessibility to the business, and develop local guidance to clarify whether displays must be disassembled daily or seasonally.



Street Vendors and Kiosks

Push carts, market stalls, and kiosks come in many shapes and sizes and can be occasional or regular features of a particular streetscape. These important street users can fit in single file spaces as narrow as **1 m** wide or fill **3-m** wide stretches of a street in a busy commercial or market-like context.



6.8.2 | People Doing Business Toolbox

Siting Guidance

Street vendors should be accommodated where there is a potential demand for their goods and services, such as near major intersections, transit hubs, parks, and plazas. Cities may create plans and guidelines to accommodate street vendors in relevant locations while avoiding conflicts with other users and commercial activities.

Dedicated Spaces

Creating dedicated space allows street vendors to safely and comfortably conduct their business. Avoid encroaching into pedestrian flows in crowded or narrow sidewalks, ensuring a clutter-free pedestrian clear path. Dedicated spaces can be allocated on sidewalks, in parking lanes, or in the enhancement zone.

Seating

Provide seating opportunities in areas with high concentrations of vendors while ensuring walking paths remain clear. During temporary pedestrianization of streets, the use of movable chairs, tables, and benches can be very efficient and cost effective.

Storage

Providing storage for street vendors enhances comfort and work conditions and allows them to store unsold goods in a safe place adjacent to their work area. Fixed stands for street vendors in specific areas such as plazas and esplanades can also enhance the character of the space.

Power

Providing power for vendors is very important when selling food or when vendors need electrical equipment and appliances to stay warm during the winter months. Using electrical devices, especially in confined spaces, is safer than gas, wood, or other fuels.

Water and Waste

Access to fresh water is fundamental for food vendors to ensure minimal health and hygiene standards. Provide areas with high concentrations of vendors with proper waste receptacles and efficient waste collection to maintain clean and attractive areas, and prevent unhealthy conditions. Provide separate receptacles for compostable materials such as food and other organic waste, as well as recyclable items.

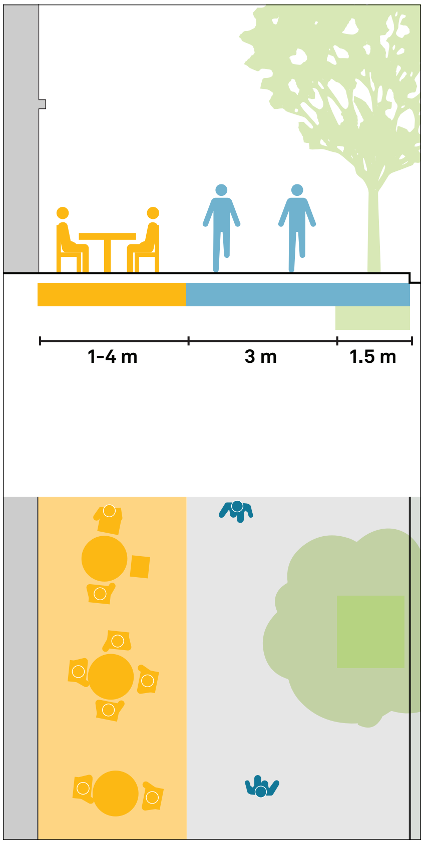
Lighting

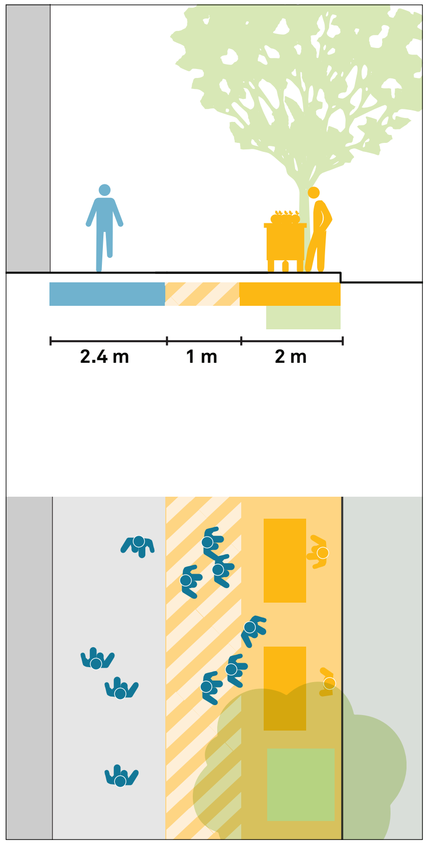
Ensure dedicated vending areas are well-lit, providing a safe environment for customers and vendors while doing business. Lighting the area encourages people to spend time and animates spaces that might otherwise be uninviting, increasing eyes on the street.

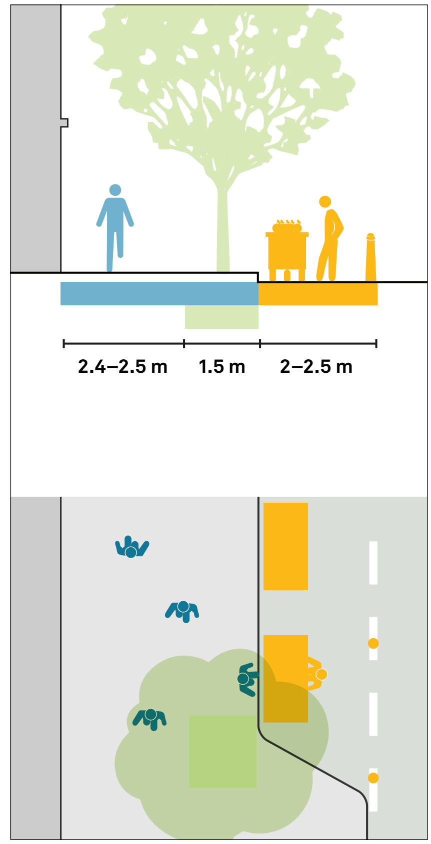
Hours of Operation

Cities may define hours of operation for on-street vending at specific locations or during specific days. Temporary pedestrianization of streets during weekends or at lunchtime can increase street activity in areas with low to moderate pedestrian volumes, or accommodate a greater number of vendors in otherwise crowded areas.

6.8.3 | Geometry







Commercial Use Extension

Ground floor extensions play a critical role in activating streetscapes, making them visually interesting and engaging, and adding valuable additional area for local businesses. From stands that display commercial goods such as clothes, books, flowers, or fruit to outdoor dining spaces that range from individual to multiple group tables, these outdoor uses should be planned and designed for. Widths of **1–4 m** can be accommodated when clear walking paths are maintained. Local permitting systems help regulate dimensions, clear paths, and hours of operation.

Vendors on Sidewalks

When sidewalks are wide enough, vendors and market stalls can be situated in the street furniture zone, providing a buffer between pedestrians and moving or parked vehicles. Allow at least **1 m** of space for vendor customers in addition to a **1.8 m** minimum clear path. When blank building facades, setbacks, vacant lots, or parking lots line the edge of the sidewalk, local vending activity can assist in activating the street and making it more lively and engaging.

Vendors in Enhancement Zone

Typically **2–2.5 m**, the space of curbside parking can be designated for vending activity. Vendors can be interchanged with seating, parked cars, loading zones, and other uses to help provide an active edge to the sidewalks while maintaining clear paths. Provide vertical protection in the form of bollards, planters, or delineators to ensure safety of pedestrians.

6.8.4 | Siting Guidance

Many cities have developed permitting systems and siting guidelines to ensure that streets can accommodate safe, convenient, and appropriate locations for commercial activities that maintain pedestrian clear paths, without pushing pedestrians into the roadbed. Work with businesses and vendors to develop guidance and policies suitable to local contexts.

Location

Street networks, context, size, and character should be analyzed to identify and map areas appropriate to accommodate commercial activity. Commercial activity should be allowed only in sidewalks that are at least **4 m** wide and should not obstruct the clear path at any time. General locations for commercial activities within the street include:

- Adjacent to building edges as extensions of ground floor uses.
- In sidewalk furniture zones.
- In sidewalk extensions or parking spaces.

Clearance Distances

When located in the furniture zone of a sidewalk, vendors and stalls should be placed at least:

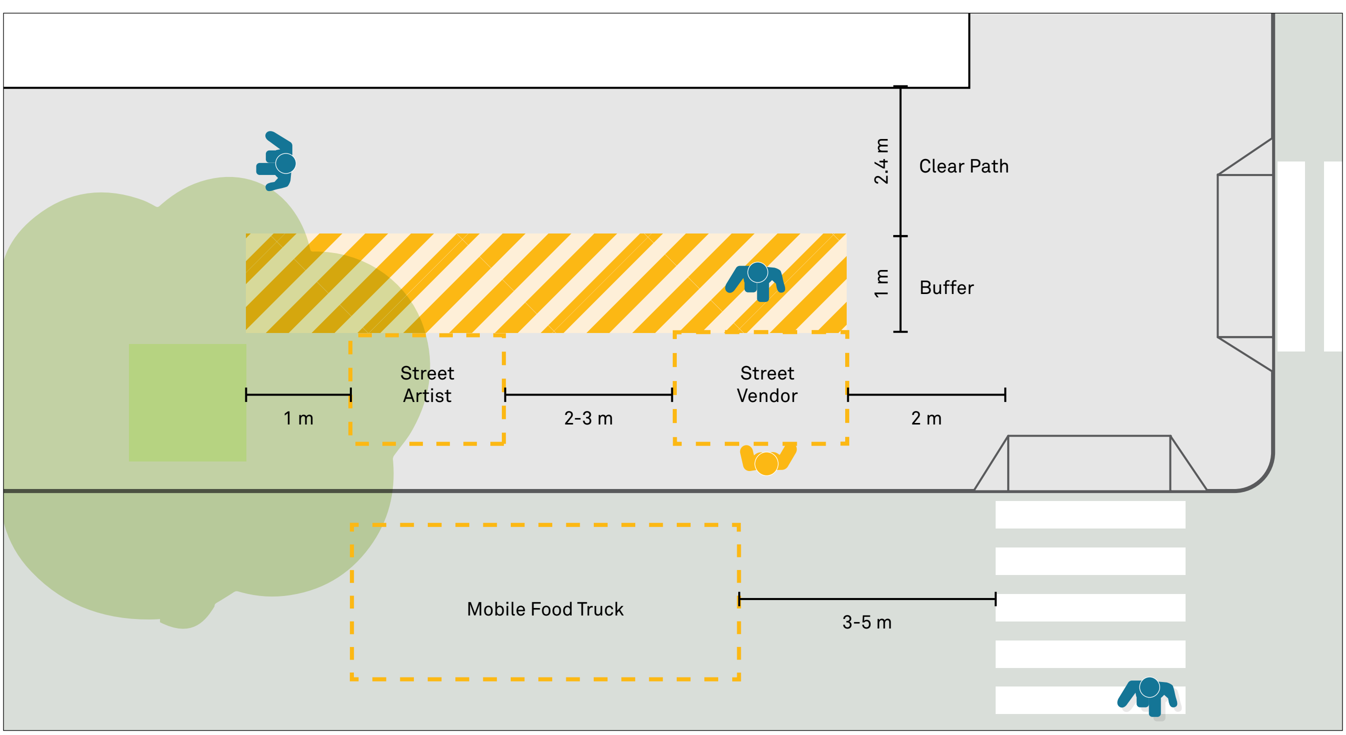
- **0.5 m** from curb edges
- **2 m** from street furniture such as benches and fire hydrants.
- **1.5 m** from trees and planters.
- **2.5 m** from transit stops, boarding zones, and loading zones.
- **3 m** from pedestrian crossings
- **6 m** from building entrances.

Demarcation

Use markers embedded in the paving, paint or chalk lines, bollards, or a change in material to visually indicate areas allowable for commercial activity.

Communication of Siting Guidance

Ensure local guidance and regulations for commercial activities on the street are visually communicated, easily available in printed and online formats, and are provided in multiple languages for the widest reach possible.



ORGANIZING VENDORS; SINGAPORE, SINGAPORE

Singapore boasts over 100 dedicated street food or hawker food markets, which are open-air food courts with organized vendors and adjoining seating facilities. Albert Mall and Waterloo Street are examples of streets that have been pedestrianized to accommodate high volumes of pedestrians and street vendors.

It took almost six years to complete and formalize these projects, which started in 1992. Since the completion, they have become precedents for other areas in the city. Located close to temples and other attractions, the organized vendors sell various cultural goods and foods. The vendors are organized by the Urban Redevelopment Authority of Singapore, as part of the National Art Council's Busking Program.

Street vendors in Singapore

STREET VENDING POLICIES BANGKOK, THAILAND

The Bangkok Metropolitan Area identified over 40,000 official street vendors as of 2010, with about 50% authorized to vend in designated spaces. The City of Bangkok has become more lenient, accommodating, and sometimes supportive of vending in certain locations, recognizing its importance to the culture and economy of the city and the livelihood of millions of people. Policies concerning street vending in Bangkok have set standards with regard to the environment, hygiene, and poverty reduction. Bangkok's *Policy Regarding Street Vending: 1973–2013* laid out regulations that allowed vendors to sell at spaces arranged by the Bangkok Metropolitan Authority daily without having to pay any fees, save for a small amount for cleaning of the footpath on which they put their stalls. These policies help acknowledge these once informal markets, enforce cleanliness and hygiene, and support local commerce.

Bangkok, Thailand

STREET VENDOR GUIDE NEW YORK CITY, UNITED STATES

The *Street Vendor Guide* was developed in 2009 by the Center of Urban Pedagogy, together with artist Candy Chang. The guide is a brief document designed to help the city's 10,000 street vendors become aware of their rights and responsibilities. It is a graphic representation of the do's and don'ts for street vending and is available in over ten languages, including English, Bengali, Chinese, Spanish, and Arabic. It also includes a history of street vending, personal stories by vendors, and related policy reforms. It has become a powerful tool equipping vendors to do business better and deal with uninformed authorities or enforcement agencies.

Street vendors in New York City reading the *Street Vendor Guide*


Ridge St
STOP
40
AREA

7

Utilities and Infrastructure

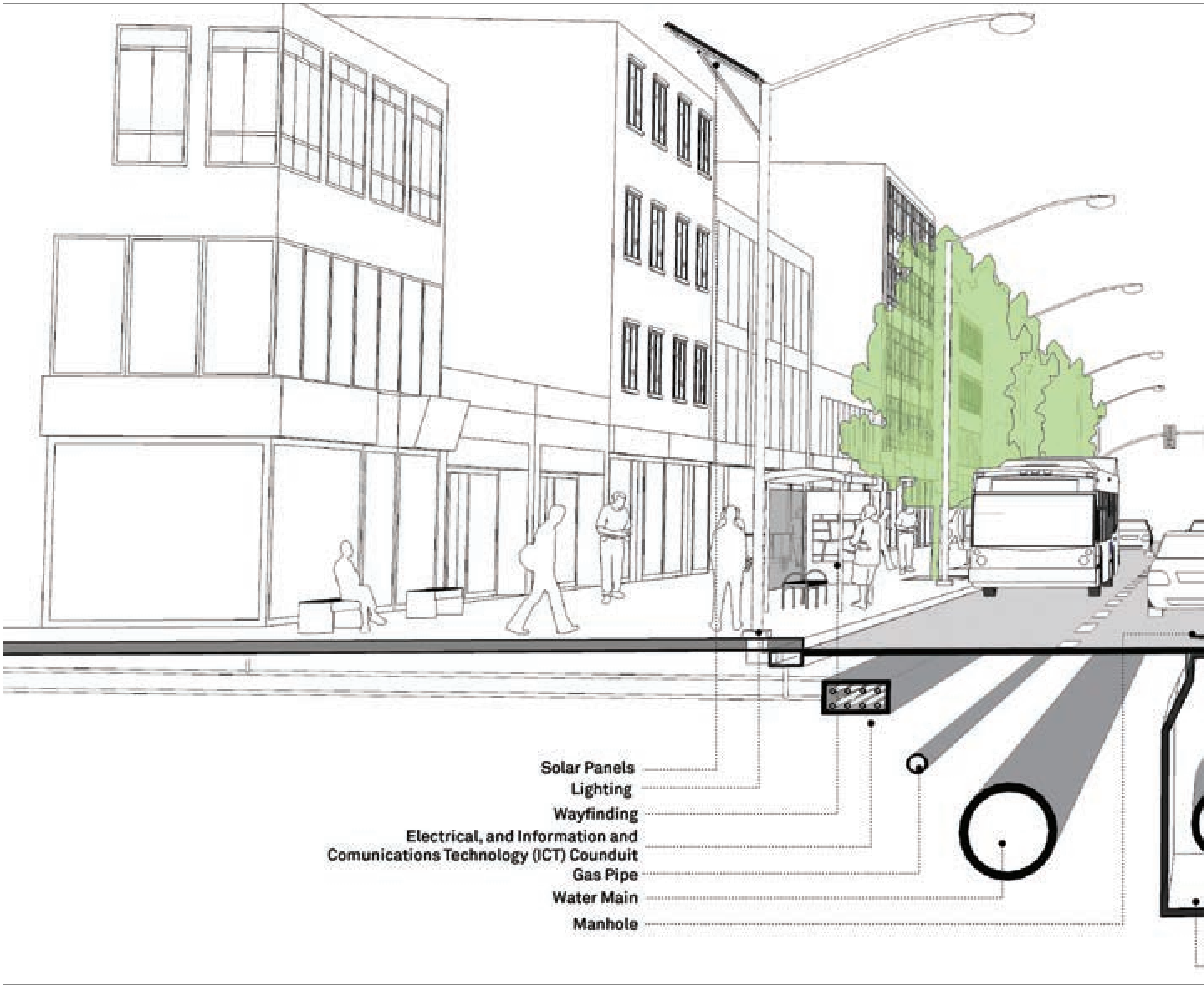
Utilities provide basic needs that significantly improve a community's quality of life, spurring social and economic growth. Improper planning and maintenance of utilities, however, can limit the economic viability of an area. Utilities and infrastructure planning and maintenance involve a large number of agencies and stakeholders. Inter-agency coordination, especially when it comes to street works, is critical. Common issues include high costs and lack of cost certainty, complex regulatory processes, lack of coordination, the state of existing utility plans, and spatial impacts.

Integrated planning is also critical; the opportunities and vision for landscaping and green infrastructure must be coordinated with the planning of utilities and street infrastructure.

The need for comprehensive planning is exemplified in green infrastructure, an increasingly common approach to managing stormwater and natural resources to foster healthier environments. Effective technologies and lighting can help improve the usage and perception of streets, mitigating user conflicts and providing a sense of safety. These technologies are adopted to aid in security and surveillance, and to enhance the user experience through navigation systems, information distribution, and user activated signals.

Sydney, Australia

7.1 | Utilities



Stormwater and Wastewater

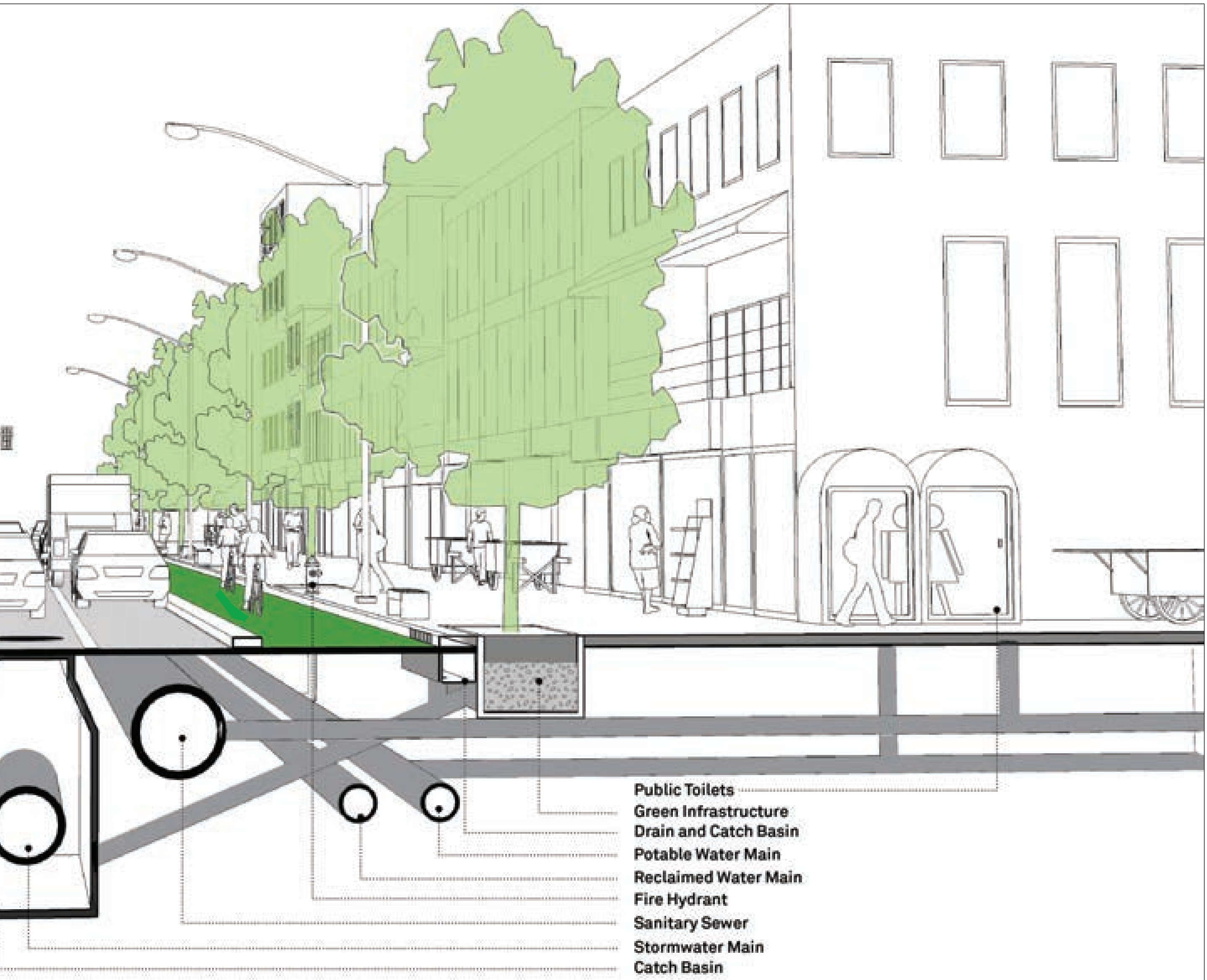
Stormwater and wastewater infrastructure helps maintain public health and hygiene. It mitigates environmental risks like flooding, sewer overflows, and water pollution. The stormwater system collects precipitation and water overflows. Wastewater pipes connect homes and buildings along streets to a main sewer leading to a wastewater treatment facility. In some instances, these are separated systems; in others, they are combined.

Electricity and Communication

Electricity supply and communication infrastructure are vital to both streets and the city as a whole. Electricity and communication cables serve street lighting and signals, and services for homes and businesses along the street. It is a critical service to support social and economic investment in the area. Streets may house infrastructure to benefit sustainable communities such as solar panels and public WiFi hotspots.

Water Supply and Firefighting

Clean and potable water should be distributed throughout the city by a comprehensive network of water supply pipes. Typically, these pipes work on the principles of gravity and should be aligned with street grids. Water used for firefighting can be carried through dedicated or shared pipes connected to fire hydrants.



Green Infrastructure

Green infrastructure strategies complement stormwater and wastewater infrastructure. Green infrastructure reduces strain on stormwater systems through infiltration or evaporation, which also improves the quality of the street environment. *See 7.2: Green Infrastructure.*

Lighting

Ensure safe, continuously illuminated streets for all users, particularly in pedestrian areas and conflict zones such as pedestrian or bike crossings and intersections. Power street lights through underground electric cables or built-in solar panels. *See 7.3: Lighting and Technology.*

Public Toilets

Provide public toilet infrastructure along major street corridors and in underserved or poorer neighborhoods, improving quality of life by maintaining access to clean sanitation facilities for all.

7.1.1 | Underground Utilities Design Guidance

Manila, Philippines
Exposed gas valve pipes and meters.

São Paulo, Brazil
Drainage channels under construction for a street repaving project.

Considerations

The installation, maintenance, and repair of utilities generally involves a large number of public and private agencies, requiring effort for coordination and integrated planning.

Advance notice and coordination between agencies regarding planned maintenance work is one of the most effective tools for reducing common issues and externalities.

While installing new underground utilities, coordinate the location of other utilities with the relevant agencies as it may conflict with their guidelines. Utility planning, design, and maintenance decisions greatly depend on the design and the operation of the overall system.

For each street, consider soil types and permeability rates, location of bedrock, vegetation, depth to groundwater, water quality and quantity, rainfall, local climate, and temperature extremes such as frost and heat.

Design Guidance

Provide setbacks, spacing, and depth of cover guidelines in accordance with municipality and utility requirements. The depth of cover is measured from the top of pipe or conduit to finished grade.

Install utilities prior to completion of new road and sidewalk surfaces. When introducing utilities under or along sidewalks, medians, parking spaces or buffers, or travel lanes, install them before above-grade street reconstruction and finishing. All building connections should be installed up to the property line.

Place priority utilities in more accessible areas to avoid frequent traffic interruptions, especially to high-capacity lanes. Priority should be given to utilities accessed most frequently:

1. Communication
2. District cooling
3. Gas
4. Wastewater
5. Stormwater

Install flexible, pressurized utilities such as water and gas above gravity-run pipes.

Base utility materials on site-specific and local regulatory requirements. Consider any anticipated loading from the finished grade and select materials accordingly.

Check local soil conditions and water tables for minimum depths of underground utilities. If the minimum depth required cannot be achieved, protect utility lines beneath roadways by encasing them in concrete.

Run utilities parallel to the sidewalk or the roadway. Surface elements such as manhole covers and service boxes should sit flush. Design surface elements to hold the weight of large freight vehicles.

Use root barriers in tree pits to direct growth downward. Ensure that pavement surrounding pits is compacted sufficiently to discourage roots from damaging the pavement.

7.1.2 | Underground Utilities Placement Guidance

Option 1
Install Utilities in the Roadbed

Advantages
- Reduces construction time
- Land acquisition savings
- Allows compact, walkable streets

Disadvantages
- Repair may cause disruption to transit, cycle lanes, and traffic
- Additional protection may be required due to continuous traffic loading

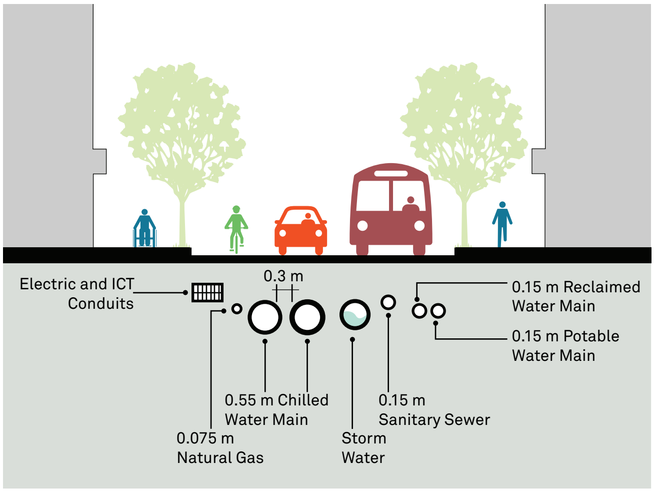


Diagram showing utilities installed under the roadbed.

Option 2
Install Utilities Adjacent to the Roadbed

Advantages
- Prevents closure of traffic lanes during construction and repair
- Requires less protection due to lower traffic volume
- May reduce need to acquire land for future roadway expansion

Disadvantages
- Greater space requirement
- Loss of pedestrian area during repair and maintenance

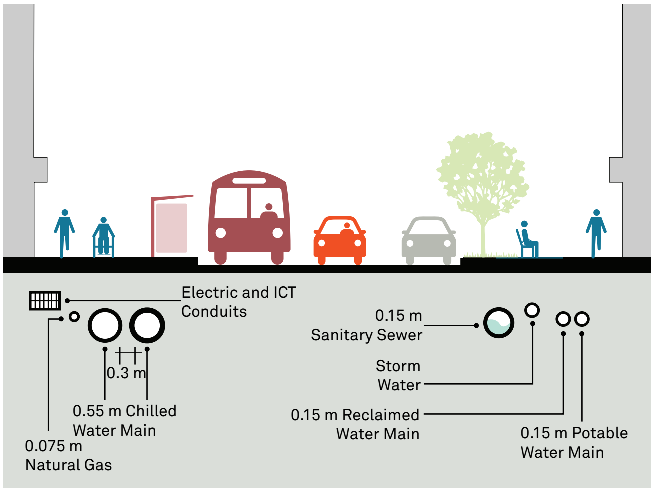


Diagram showing utilities installed adjacent to roadbed.

Option 3
Install Utilities Within the Underground Corridor

Advantages
- Ease of access for servicing
- No traffic impact during maintenance
- Lower maintenance costs

Disadvantages
- Significant capital costs required
- Longer construction time
- Compatibility between utilities must be considered
- Flood measures required
- Ventilation shafts required
- Wet utilities should be kept separate from dry utilities

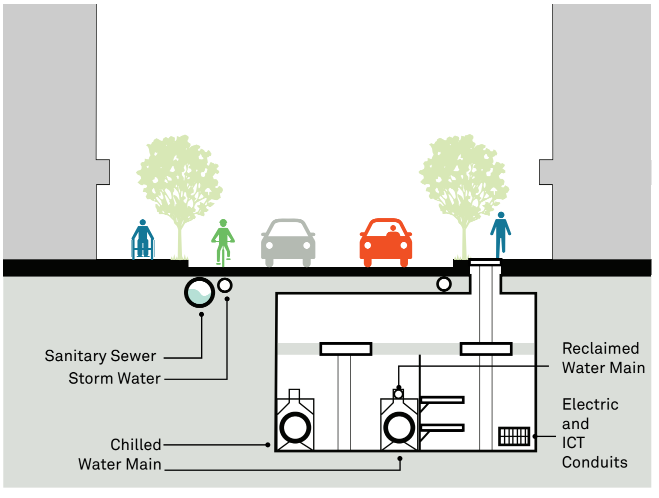
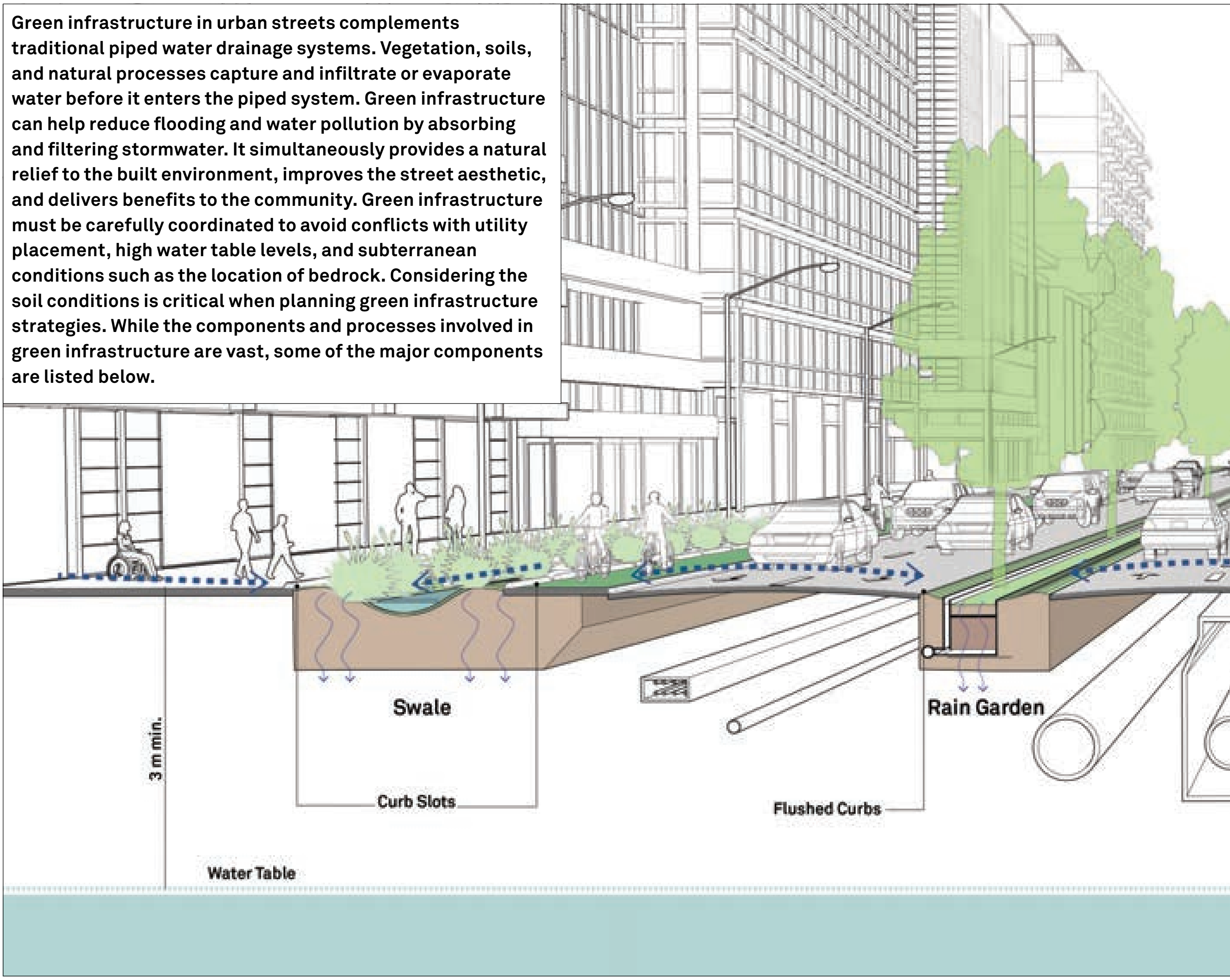


Diagram showing utilities installed in an underground corridor.

7.2 | Green Infrastructure

Green infrastructure in urban streets complements traditional piped water drainage systems. Vegetation, soils, and natural processes capture and infiltrate or evaporate water before it enters the piped system. Green infrastructure can help reduce flooding and water pollution by absorbing and filtering stormwater. It simultaneously provides a natural relief to the built environment, improves the street aesthetic, and delivers benefits to the community. Green infrastructure must be carefully coordinated to avoid conflicts with utility placement, high water table levels, and subterranean conditions such as the location of bedrock. Considering the soil conditions is critical when planning green infrastructure strategies. While the components and processes involved in green infrastructure are vast, some of the major components are listed below.



Swale

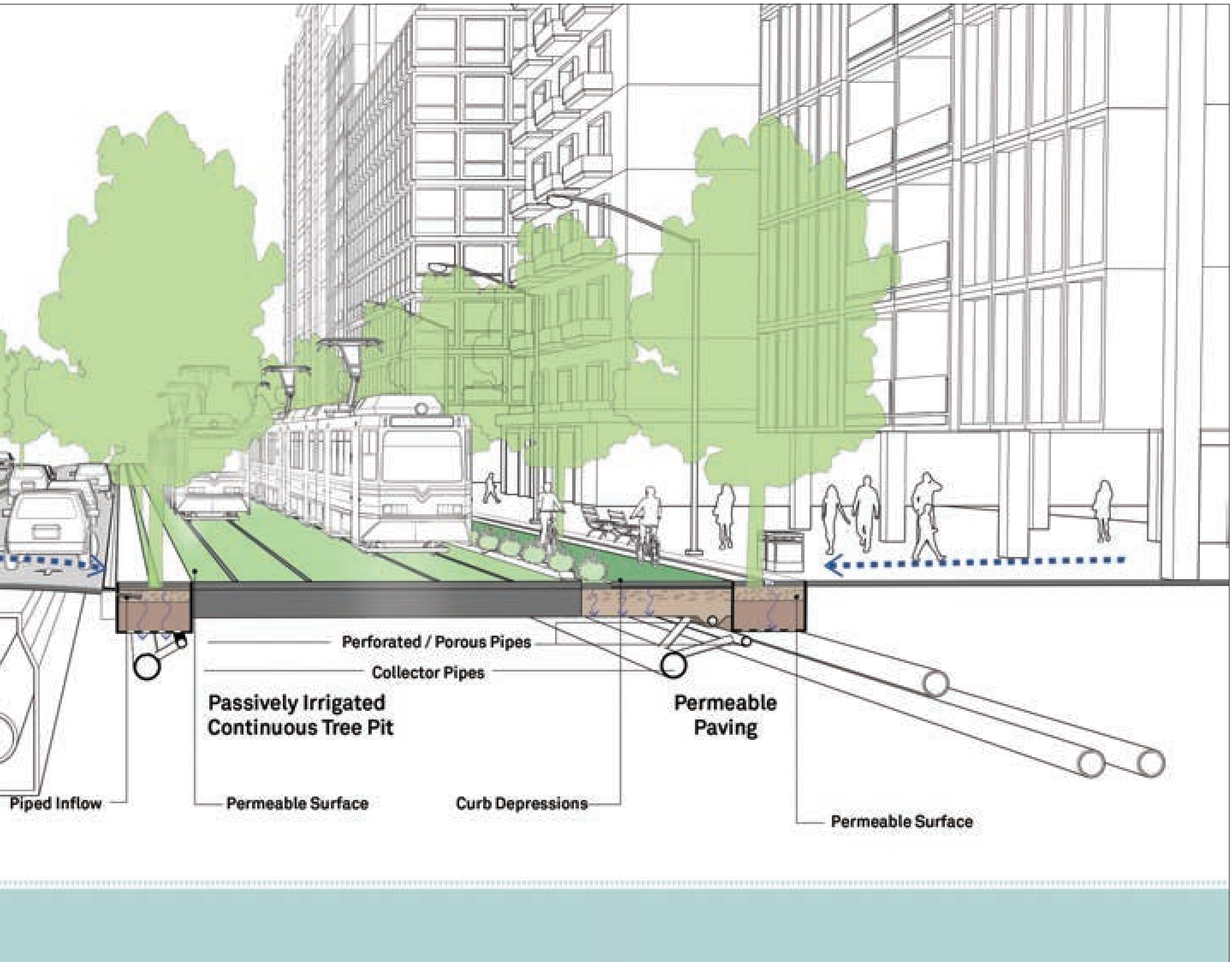
Swales carry water like pipes and are designed as shallow, open, planted channels to convey runoff and remove pollutants. They are an alternative to a piped drainage system where space and grade is available. Water moves horizontally along the surface or in subsurface layers. Swales slow water flow and trap sediments to improve the water quality.

Rain Garden

Rain gardens have a special soil filter media that can remove pollutants from road runoff. Configure plant and soil filtration systems as garden beds or street tree pits such that they are designed to treat stormwater runoff. Rain gardens are also called bioretention systems, flat bioswales, flow-through planters, or pervious strips. Some are designed to allow water to infiltrate underlying soils while others are designed to collect the treated water and convey the clean water downstream.

Permeable Paving

Permeable paving allows rainfall to move through the pavement to the soil beneath and provide water to landscape areas nearby. Alternate surfaces with permeable pavement to reduce stormwater runoff and recharge the water table. These may be in the form of block pavers with infiltration gaps between pavers, or porous material with infiltration gaps within the material.



Street Trees and Planting

Trees provide shade and cool the air, benefitting the comfort of people using the street. While designing, find opportunities for plants and trees within the streetscape to reduce the amount of hard, impermeable surface. Plan and set aside adequate space for trees in the early stages of development to achieve better outcomes. Plant trees in green strips, parking bays, and rain gardens. High-quality plant stock and appropriate planting techniques are vital to the success of any planting.

Tree Pit and Soil Volume

Continuous tree pits increase the plantable surface area and provide more space for tree roots. Ensure sufficient growth area, soil volumes, and hydration for trees. Coordinate tree planting with other infrastructure elements to avoid conflict, particularly with transportation and utilities. Where space is constrained, consider employing suspended and permeable pavements, strata cells, structural soils, and passive irrigation to improve soil conditions and overall health.

Passive Irrigation

Directing stormwater to the surface of landscaped areas and tree pits provides irrigation to the plants and reduces stormwater runoff into local drains and citywide systems. Passive irrigation is one of the simpler and easier ways to incorporate water-sensitive design.

7.2.1 | Green Infrastructure Design Guidance

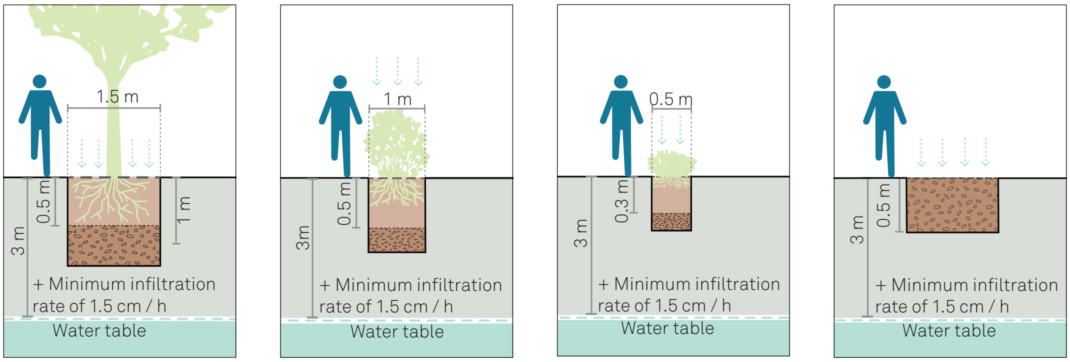


Diagram showing minimum width, depth, and infiltration rates required for a variety of tree-pit types.

Design Considerations

Plan green infrastructure in conjunction with regional systems, taking into account conditions such as the water table, topography, and local climate. Consider the following design criteria:

Groundwater Table. Maintain a minimum of **3 m**, with **1 m** under drains, from the ground surface to the top of the groundwater table for all green infrastructure.

Soil Permeability. A minimum infiltration rate of **1.5 cm/h** is required for green infrastructure. If infiltration rate is less, use underground storage tanks to hold excess water.

Underdrainage. Create proper underdrainage as a combination of fine aggregate placed under drainage pipes to allow treated stormwater to leave the rain garden.

Design and Grade for Swales. Carefully design the size, longitudinal grade, and location of swales to ensure that localized flooding does not occur. The grade should be between **2%** and **5%**. If the grade of the swale is less than **2%**, the base may become clogged. If the grade is greater than **5%**, issues with erosion and damage to the vegetation are likely.

Vegetation. Use plants that are tolerant of extended dry periods and periodic inundation, typically native grasses, sedges, shrubs, and trees. The plants absorb soil nutrients, support biological growth, maintain soil porosity, and prevent surface clogging of the filter media.

Climate Considerations

High Rainfall. Locate inflow and outflow structures close to each other or design the system to feed the inlet from the back, and allow high flows to bypass the system completely. Avoid pavers with loose material as these are vulnerable to erosion. Passive irrigation can be used for all climate zones but is most effective where rainfall is regular.

It is important that high water flows do not erode the vegetation or swale surface. Ensure that the swale width is adequate for the catchment and the expected velocities of water.

Dry Climates. Ensure filter media retains soil moisture with suitable media type and depth to sustain vegetation. Using a saturated zone bioretention system is the most effective way of maintaining planting health for longer periods between rainfalls. Select drought-tolerant vegetation.

Cold Climates. Apply salt, sand, or cinder to streets in moderation to reduce contamination of subsoil in snowy climates. Plowing should be done carefully, and abrasives such as sand or cinders should be avoided to preserve the integrity of the system.

Placement Considerations

Ensure adequate pedestrian access and emergency egress within the sidewalk.

Curbside Strips Within the Sidewalk. Distribute green infrastructure along the sidewalk as continuous or non-continuous strips, while maintaining a clear path for pedestrians. These strips can consist of various green elements such as tree pits, swales, rain gardens, and permeable paving.

Curb Extensions. Use curb extensions to place smaller areas of green infrastructure. Place rain gardens and tree pits at intersection gateways, on bus bulbs, or between on-street parking spaces.

Side or Central Median. Provide green infrastructure within the side or central medians, depending on the grading of the street and the underground conditions. Medians help manage water runoff from adjacent impermeable surfaces.

Species Selection

At the core of any green infrastructure strategy is the goal to build resilience into the system. As climate change and other environmental threats impact urban forests and green infrastructure, their viability ultimately hinges on their durability and adaptability. Traditionally, many cities have concentrated on planting a handful of species, rendering them vulnerable to pests, disease, and extreme weather. Species selection and increased diversity is central to creating resilience.

Species selection should ensure tolerance for today's climate and resilience for future change. Consider the following criteria when planting within an urban context:

- Drought tolerance
- Compaction tolerance
- Heat tolerance
- Wind tolerance
- Longevity
- Pollution tolerance
- Pest and disease susceptibility
- Potential as an allergen
- Sun and shade tolerance
- Predicted maintenance
- Mosquito breeding

7.2.2 | Benefits of Green Infrastructure

Auckland, New Zealand

Lisbon, Portugal

Portland, USA

Environmental

Habitat and Biodiversity. Green streetscapes enhance urban biodiversity as native species provide habitats for birds, insects, and other species. Native vegetation is better suited to the rainfall of the local area. Enhancement of biodiversity in cities can increase environmental awareness among urban residents.

Water Quality. Green infrastructure improves stormwater quality by reducing the load of sediment, unwanted minerals, and other contaminants that are carried with runoff from impermeable surfaces.

Flow Management. Retaining runoff in landscaped areas and slowing the rate of flow from the catchment area reduces the risk of erosion of the soil bed. Slower flow rates reduce stress on downstream waterways as well.

Natural Hydrology. Where local soils are suitable, rain gardens are used to treat stormwater before it permeates the groundwater.

Passive Irrigation. Directing stormwater to irrigate the planting reduces the need for manual watering and increases soil moisture.

Social

Amenity and Landscape Design. Landscape design contributes to a city's character and identity. Planting complements the built environment, softens appearance of hard surfaces, and provides a visual screen.

Urban Cooling. Trees and green infrastructure provide significant reductions in urban temperatures. Large trees with good soil moisture can reduce local temperatures through shading and evapotranspiration. Trees can reduce air temperatures in parks and green areas by as much as 2–8°C, and they have been linked to the prevention of unnecessary loss of life during heatwaves.[1]

Encourage Outdoor Activity. Green cover encourages outdoor activity, including walking, cycling, and other recreation.

Air Quality. Vegetation improves air quality and reduces greenhouse gases. Trees remove carbon dioxide, nitrous oxides, sulphur dioxide, carbon monoxide, and ozone from the atmosphere. The most effective species in trapping pollutants are those with large leaf surface areas and high transpiration rates.

Economic

Energy. By reducing local temperatures and shading building surfaces, green infrastructure reduces the cooling demand of buildings, thus cutting energy needs.

Lifespan of Infrastructure. Green infrastructure complements grey infrastructure such as catch basins and drainage pipes, and lengthens the lifespan of grey infrastructure.

Water Systems. The impacts on drainage systems and the cost of managing erosion in waterways can be significant. Streets with green infrastructure slow the rate of runoff, reducing the pressure on these systems and lowering maintenance costs.

Property Values and Marketability. Street trees and green infrastructure enhance aesthetic qualities and provide a significant neighborhood amenity. Properties on tree-lined streets are valued at up to 30% more than those on streets without trees.[2]

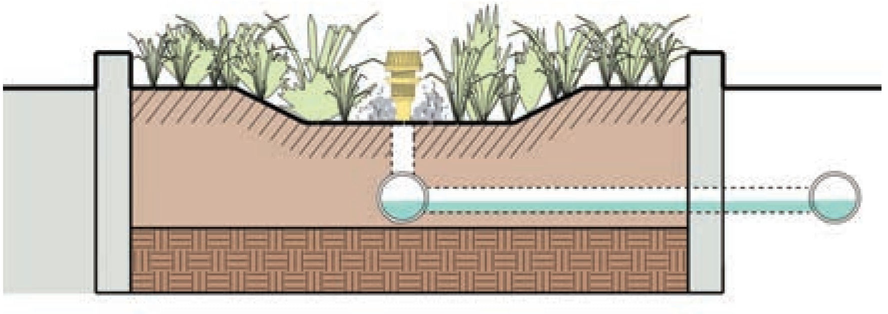


Diagram showing bioswale cross-section with drainage pipes that connect to the larger stormwater collection system. The engineered soil mixture should consist of 5% maximum clay content, maintain a clearance of at least 1.5 m from the bottom of the bioswale to high groundwater table, raise the overflow/ bypass drain system above soil surface to manage storms larger than the water quality event, and discourage pedestrian trampling by using low curbs or barriers, or hardy vegetative ground covers.

7.3 | Lighting and Technology

Lighting can improve quality of life by creating inviting, safe, and lively streets. When designed well, lighting can reduce energy consumption, minimize light pollution, and add to the sense of place and character of a street.

Technology can play a key role in the operation and management of a street, but it should not come at the expense of good geometric design. New technologies can help reduce and declutter certain street furniture, organize and combine the functions of physical elements, and rethink outdated elements.

Lighting

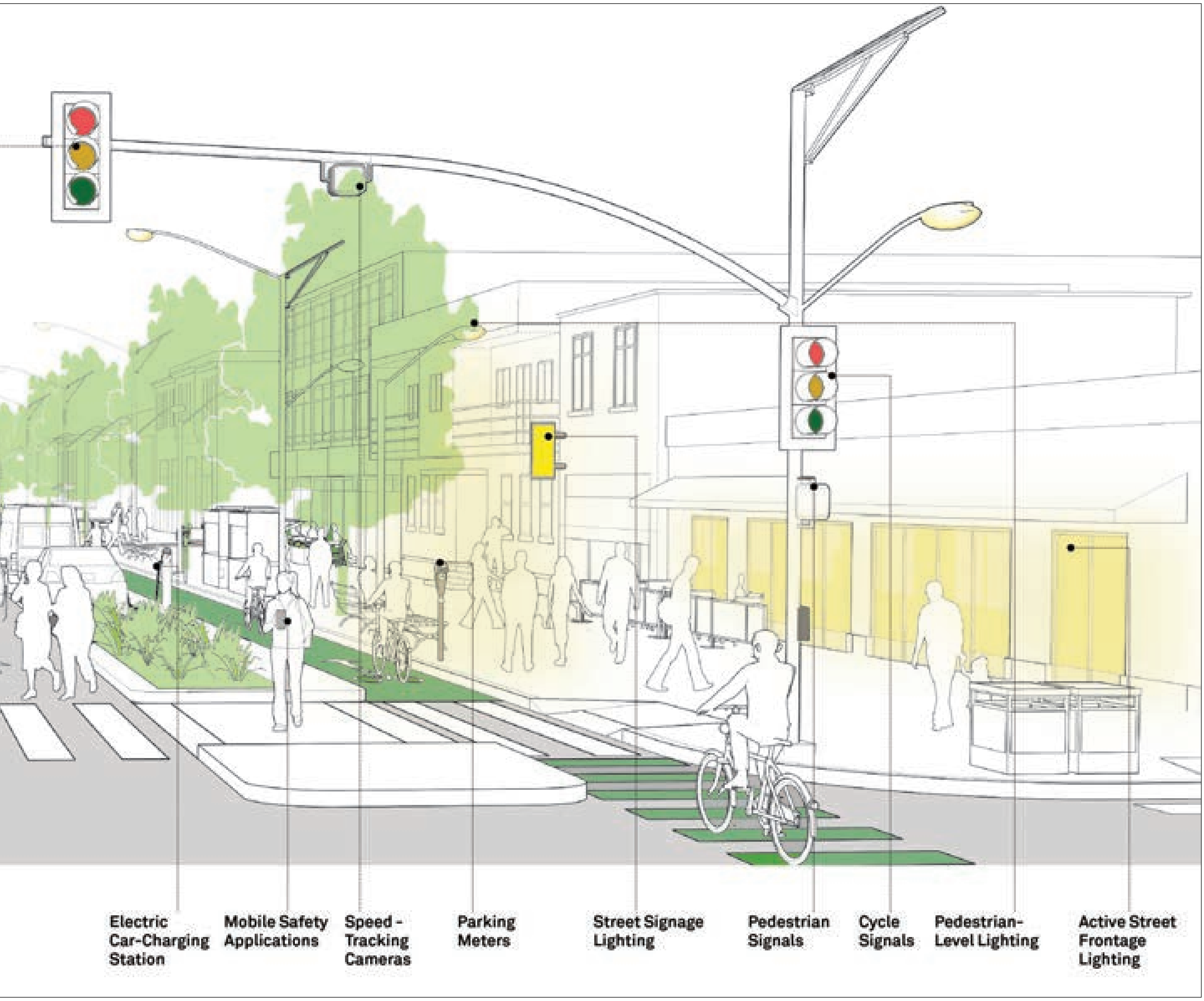
Evenly illuminate streets to give pedestrians, cyclists, and drivers better nighttime vision and improved perception of safety and comfort. Provide lighting along all public rights-of-way, especially in conflict areas such as intersections, pedestrian crossings, and cycle crossings; pedestrian facilities such as sidewalks, plazas, and underpasses; transit facilities such as bus stops and transit hubs; and narrow streets such as laneways and alleys.

Wayfinding and Signage

Enhance user experience through navigation systems and signage. Interactive wayfinding technologies and real-time transit information systems increase ease of use and can be programmed to be universally accessible. Use signage for speed limits, parking zones, and other operational strategies to help communicate regulations. Distribute these signs and navigation facilities across the multiple planes of a street to ensure legibility for all street users.

Sensors and Signals

Sensor-activated lighting can help prevent energy loss and create safer spaces for pedestrians at night. Adopt signal detection and actuated signals where appropriate to improve user experience, energy efficiency, and safety. Multi-user signal coordination can help street networks function smoothly and adapt to daily needs during peak hours and other scenarios. *See 8.8: Signs and Signals.*



Enforcement and Security

Install devices for surveillance and monitoring of streets to improve automobile vigilance and the perception of safety. Security cameras installed by public agencies or private property owners can help to monitor speeding vehicles, crime, and other unwanted activities in neighborhoods with low human activity at certain times of the day. Traffic safety cameras and other similar devices help enforce speed limits and parking regulations with reduced manpower and human error.

Real-Time Data Collection

Adopt the practice of gathering helpful data that improves user quality and overall street management. Consider installing real-time data collection devices like air-quality monitors and cyclist or pedestrian counters. Off-board transit ticket machines, vending machines, and bike share stations can also provide real-time data. As data is collected, consider making it available through an open data platform for researchers, organizations that can use it to create resources such as transit maps and schedules, and to inform future design projects.

Information Technology

Aim to create intelligent ecosystems on streets by incorporating amenities such as WiFi access points, mobile phone applications, real-time transit information, and transit, bikes, and car-sharing facilities. These systems not only aid in making streets more efficient but also invite greater street activity. Intelligent systems provide data that can be used to guide future needs and street design projects.

7.3.1 | Lighting Design Guidance

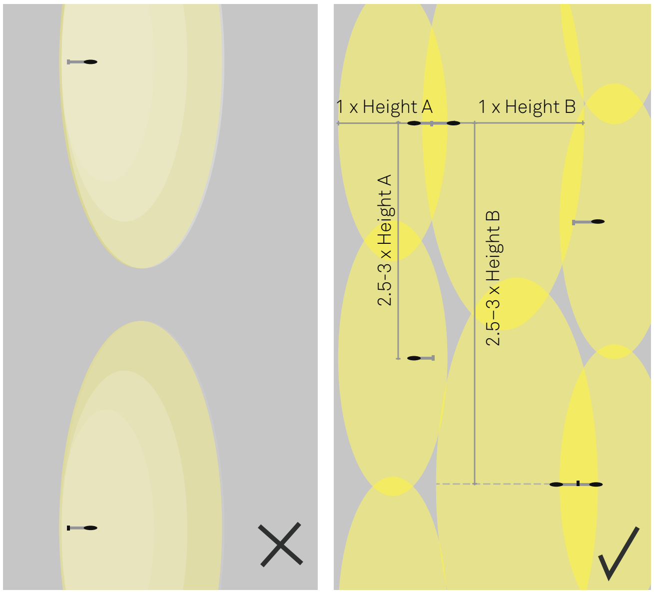
Dimensions and Spacing

Space light fixtures to provide uniform distribution and illumination of roadways and sidewalks. Consider the locations of obstruction such as trees or billboards.

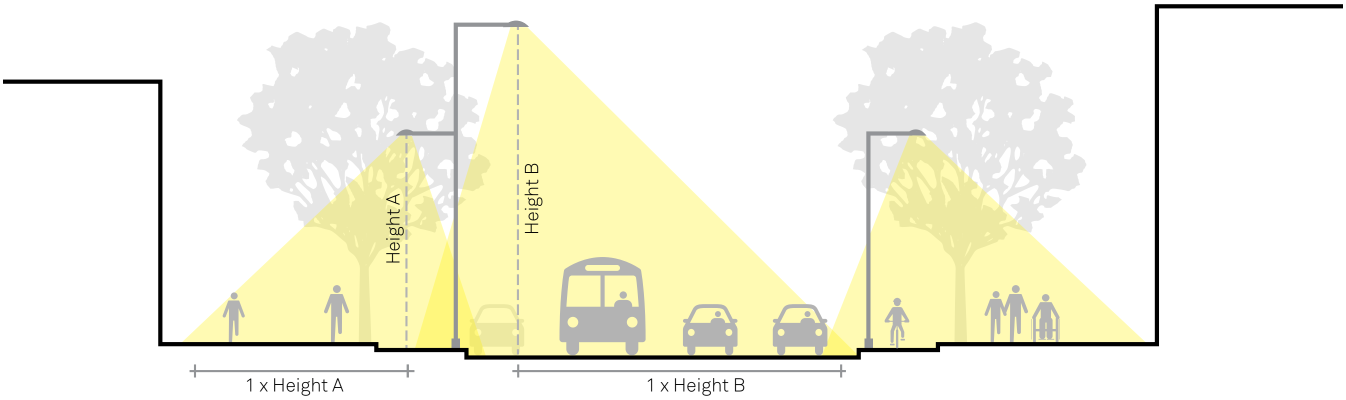
Height. Standard poles for sidewalks and bike facilities are **4.5–6 m**. Light poles for roadbeds vary according to the street typology and land use. In most contexts, standard heights for narrow streets in residential, commercial, and historical contexts are between **8–10 m**. Taller poles between **10 m** and **12 m** are appropriate for wider streets in commercial or industrial areas.

Spacing. The spacing between two light poles should be roughly **2.5–3** times the height of the pole. Shorter light poles should be installed at closer intervals. The density, speed of travel, and the type of light source along a corridor will also determine the ideal height and spacing.

Light Cone. The light cone has roughly the same diameter as the height of the fixture from the ground. The height will therefore determine the maximum suggested distance between two light poles to avoid dark areas.



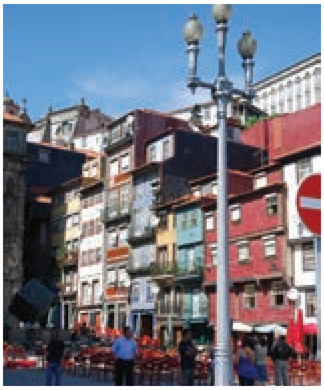
Measure the width of the street and the height of the proposed light poles to determine the required spacing of lights for even coverage. Light poles that are spaced too far apart result in dark areas that leave street users feeling unsafe.



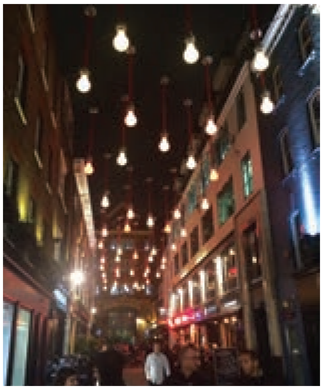
The spacing between light poles is typically 2.5–3 times the height of the fixture. A single row of light poles might be sufficient for a narrow street, while wider streets will require multiple rows.

Varied Light Sources

There is a wide range of light sources that contribute to the overall illumination of the public realm. Well-designed solutions incorporate different types of light sources such as conventional and decorative fixtures, pole-mounted lights, hanging catenary lights, as well as signage and advertising illumination. Borrowed light spilling from storefront or domestic interiors, lights mounted to building exteriors such as hanging lanterns and facade lighting, and lights from cars may add to street illumination at certain times of the day. However, borrowed illumination may not always be consistent, evenly distributed, or designed for human comfort.



Lisbon, Portugal
Street light in historic district.

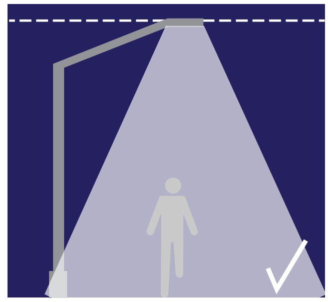


Central London, United Kingdom
Hanging light installation used to illuminate a narrow alley.

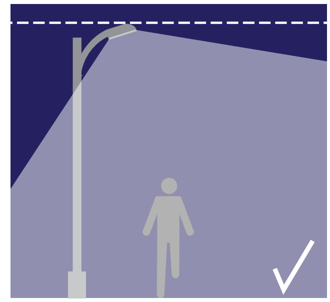
Light Pollution

Focus lighting from light poles and fixtures directly onto the street to minimize glare and light pollution that could negatively impact wildlife and human well-being.

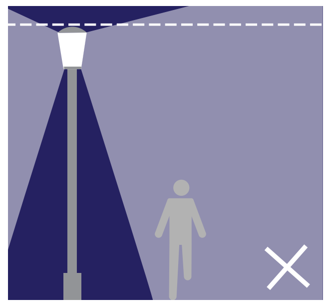
Shielded and cut-off fixtures with energy-efficient light bulbs are more cost-effective as they use less energy by directing the light toward the ground, reducing light pollution.



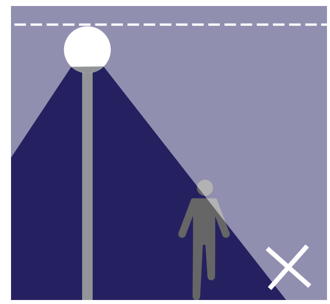
(a) Full Cut-off Fixtures



(b) Fully Shielded Fixtures



(c) Non-Shielded Fixtures



(d) Upright Light Poles

Best practices suggest light poles with fixtures parallel to the ground, also called full cut-off fixtures (a). When slightly rotated, fixtures should be fully shielded (b). Avoid fixtures that are not properly shielded (c) and upright light poles (d), which emit light toward the sky.

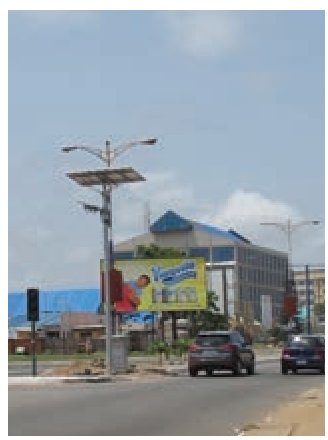
Energy Efficiency

Low-energy solutions such as Light Emitting Diodes (LED)–minimize energy consumption and light pollution. LEDs have a long lifespan of 50,000–70,000 hours when not operated at high temperatures.

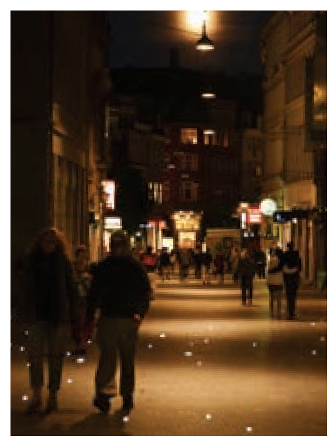
An emergency power source such as a back-up generator should be considered for lighting along major corridors, especially where electricity supply is unreliable or where storm events may cause power loss.

Alternative power sources such as solar panels or battery-operated lighting are appropriate in areas where power is not always easily accessible, such as informal developments.

Where a complete street lighting network is not feasible, local authorities should consider interim lighting solutions such as portable lanterns. Buildings within certain districts may be required to display or provide spill or signage lighting at night.



Accra, Ghana
Solar-powered street lights to reduce energy dependency.



Copenhagen, Denmark
LED lights embedded in the pavement.

Temperatures, Colors, and Ambience

A consistent approach to color temperature should be applied throughout the lighting plan, although different color temperatures can be used to signify different users or types of travel. 3000 Kelvin (K) is often used for pedestrian paths and 5000K for vehicular paths.

Edinburgh, Scotland
Ambient environment created with street lights and storefronts.


10
CHEAPSKAT
24 hour fitness
SHARED
ZONE
Ps
120
Pay and Display Zone
Extended to 8pm Friday
Begins

8

Operational and Management Strategies

Over the past 75 years, the transportation industry has developed a toolkit of operational techniques to make roadway networks function for large numbers of vehicles, to the detriment of other users and cities themselves. As motor vehicle use has increased, so have traffic fatalities, congestion, and local air pollution. These impacts have made walking, cycling, and on-street transit use increasingly difficult and uncomfortable, resulting in demand for vehicle trips even for short distances that could easily be covered on foot. Thus, the prioritization of motor vehicles has increased congestion to the point where the time advantages of vehicles are negligible, even as the cycle of congestion and roadway expansion continues to push transit, walking, and cycling to the margins in many cities.

Cities that seek to reverse the growth of traffic demand need to create effective and comfortable operating conditions for transit, cycling, and walking, insulated from motor vehicle congestion. The engineering tools of traffic operations, historically used to increase vehicle capacity, can also be used to reverse this trend. This chapter covers strategies to actively manage volume, demand, and speed within urban networks, to create safe spaces for more spatially efficient modes.

Wellington, New Zealand

8.1 | Overview

Copenhagen, Denmark

Operational techniques are a powerful set of tools that can help cities achieve their goals by prioritizing safety of vulnerable users and promoting sustainable transportation modes. To provide an efficient and equitable transportation network, cities must balance regional and local movement while shifting to spatially efficient modes and reducing reliance on private vehicles. The street management framework uses street operations, alongside street design, allocating valuable road space based on safety, user characteristics, access demands, and broad policy goals.

This proactive approach to street operations integrates transportation policy and infrastructure, economic and social needs, and land-use decisions in order to maximize sustainable development and use of efficient transportation modes.

The strategies discussed in this section are generally low in cost and can be implemented with basic technical knowledge. Operational strategies can be progressively modified and adapted based on feedback and performance. These principles have long been applied on access-controlled highways and rural roads but must be deployed differently in urban settings.

This approach is based on a set of priorities and goals, including:

- Design for people first, creating functional walking and cycling networks that bind the city together and provide safe access to every street.
- Integrate robust transit services for district, city, and regional travel that provide the basis for sustainable mobility, especially in large cities.
- Build safety into the system with efficient but lower design speeds in urban contexts, and ensure that higher-speed corridors are either converted to urban streets or remain outside of built-up areas, through strict development management.
- Design for coexistence between people, private vehicles, and trucks by creating a vehicle network that uses street space efficiently. Protect livability on major streets through design strategies that separate user groups and prioritize different activities on different corridors.

8.2 | General Strategies

London, United Kingdom

Copenhagen, Denmark

Malmö, Sweden

Demand Management
These strategies improve mobility, including that of private motor vehicle users, by reducing demand for space on the road. Reducing vehicle travel by adding a monetary cost to trips, reducing the number of parking spaces, or reducing vehicle capacity can help create the space needed for sustainable modes of transportation to thrive.

Volume and Access Management
These strategies physically or operationally reconfigure street space to reduce the number of private motor vehicles attempting to use the street network. This allows private motor vehicles to use city streets without dominating other modes. Prioritizing spatially efficient modes is done through the allocation of space for these users.

Speed Management
Excessive speed is the leading cause of traffic fatalities. Speed management strategies reduce speeds to ensure a safe urban environment for all road users while maintaining the efficiency of the street network.

Istanbul, Turkey

Paris, France

Fortaleza, Brazil

Network Management
An approach as much as a set of tools, network management involves permitting and restricting motor vehicle movement in conjunction with other modes of transport and street users, including tools that limit access for delivery vehicles and local traffic to specific streets.

Parking and Curbside Management
Curbside management is critical to the economic and social success of streets. Managing parking is a strong form of demand management. In many central cities, parking availability is the only real constraint on motor vehicle demand, discouraging their use and therefore reducing the volume of traffic.

Conflict Management
Managing the interaction between different street users at intersections and other crossings is a major area of traffic engineering and design practice, with profound implications for safety. Intersection operations can support urban streets by placing the safety of sustainable modes first.

8.3 | Demand Management

The surest way to improve mobility is to reduce the demand for private motor vehicle use, promote walking for short trips, cycling and local transit for medium-length trips, and regional transit for longer trips.

Citywide transit-first and active transportation-first policies empower designers to create viable alternatives to driving. Policies that accurately price parking or vehicle entry are highly effective tools in encouraging demand shift to other modes. Land use and development policies should be established in conjunction with transportation goals, as development patterns have the greatest influence on the transportation system.

São Paulo, Brazil

Strategies

Active Modes

Increase the percentage of roadway space allocated for pedestrians and cyclists using dedicated cycle lanes and widened sidewalks. Improving walking and cycling access increases transit use.

Transit

Increase transit system capacity, speed, reliability, as well as overall service quality by prioritizing surface transit, especially on congested streets. Create dedicated street space for bus lanes and trams, high-quality bus and tram stations, and improved station access by foot and cycle.

Development

Create active, mixed-use neighborhoods that are safe and easily accessible by walking, cycling, and transit. Limit peripheral development to areas near major transit hubs.

Delivery Management

Designate off-peak times for delivery of goods to reduce the impact of delivery trucks on traffic congestion during the busiest times of day. Consolidate large shipments away from the city center to allow for smaller vehicles to distribute goods in downtown areas.

Pricing

Develop pricing strategies, including parking pricing, tolling of major roadway facilities, and peak period congestion pricing for entering the most dense and active areas of the city. Vehicle and licensing fees can also be used.

Employment Hubs

Work with large employers, especially industrial firms and satellite office areas, to create transit, carpool, and vanpool or shuttle options for employees. Incentives could include financial returns such as pre-tax benefits, transit pass reimbursement, parking space cash-outs, or ride-sharing programs.

Bike Share

Develop or support a robust, densely available bike share system, greatly extending the reach of fixed-route transit and reducing the use of cars and taxis for trips inside the city center.

Car Sharing

Develop or support citywide car-sharing services, reducing the need for car ownership and parking in neighborhoods. Designated parking spaces can support these services. Shifting municipal fleets to car share vehicles can reduce the demand for parking and help incentivize car sharing.

8.4 | Network Management

Streets are a web of overlapping uses, functions, and transportation modes. Approaching street design with a network management framework allows cities to organize safe and functional streets at all times and for all people by using time and space efficiently. Engage the local community to understand current issues and develop priorities and goals for each neighborhood. Vehicle trips are often made unnecessarily because the street network does not offer safe and efficient options for active or collective modes of transport. Many of these trips can easily be converted into active or transit modes by making them equally attractive and safe.

Singapore, Singapore

Network-Based Strategies

Consider the Context
Different activities and users require different treatments. A commercial street, for example, requires more room for pedestrians, cyclists, and transit users than a support street predominantly used for loading or unloading of goods.

One-Way Streets
One-way streets are best used where streets are laid out in a grid or when there are nearby opposite direction streets to ensure network connectivity. One-way operation is well-suited for narrow streets and alleys where vehicle access is needed but two lanes are not possible. In a well-connected network, one-way streets provide high capacity per lane, freeing up space for non-traffic uses with minimal traffic impact. One-way streets should be used in conjunction with turn and speed management and traffic calming measures such as street and lane narrowing or repurposing excess road width for designated pedestrian, cycle, and transit facilities.

Two-Way Streets
Two-way streets provide increased network connectivity, especially where the street network is irregular, with frequent dead ends, or where there are limited options for continuous travel across long distances.[1] Two-way streets provide improved access and tend to reduce local vehicle distance traveled by providing more direct vehicle routes. In places with narrow road width and low vehicle volumes, two-way streets have a traffic calming effect, lowering speeds which reduces crash severity. However, on wider streets or in areas with high vehicle volumes, two-way streets can increase crash frequency due to increased complexity at intersections and turns across oncoming traffic.

Continuous Lanes
Continuous lanes move traffic along a corridor, with turn lanes where necessary. Cities should allocate the number of lanes based on need, not road width. If there is additional width, space should be repurposed for pedestrian, cycle, or transit facilities.

Separate Turn Movements
Separate turn movements where high pedestrian volumes and vehicle turn movements coincide. Use separate turn phases or turn lanes, or move turns to a different intersection with fewer foot crossings. Problematic turns should be consolidated and relocated to areas where the turns can be accommodated.

Route Metering
Use signals and other traffic control elements to reduce long vehicle queues that block pedestrian crossings and cross streets, erode the walking environment, or create the potential for gridlock. Where a large street narrows, or where a highway transitions into a street, use signals to keep queues on the larger street or highway rather than overwhelming the smaller street. When congestion exists along a route operating at capacity, bottlenecks can be moved upstream, creating room for transit, walking, and cycle facilities.

Area Metering
Reducing the volume of traffic that enters a district improves total trip times and reduces the delays for buses in mixed traffic. This reduction can be achieved through pricing, route metering, and volume and access management.

8.5 | Volume and Access Management

Streets with less motor vehicle traffic are healthier, safer, and can be used more flexibly. Managing traffic volume is especially important when changing the character of a street, for example when converting it to a shared street or a transit street.

Private motor vehicle volume on a street can be reduced by making the street less appealing as a through-route or by completely preventing through-travel on a street. Volume can be decreased substantially by restricting access for local vehicle users only.

Delft, The Netherlands

Restricted Movement Strategies

Forced Turns
Require drivers to turn at an intersection, thus limiting through-travel. The turn can be forced via regulation signage while providing a through function for authorized users such as a transit or cycles. Forced turns can also be enforced by installing median diverters or large curb extensions to channel vehicular traffic. Diverters may have cut-throughs for through-cycle traffic.

Turn Prohibitions
Prohibiting turns from high-volume streets onto lower-volume streets can be implemented through regulatory signage reinforced with through-only arrow markings and by removing any existing turn lane.

Continuous Raised Median
Block traffic on a minor street from crossing a major street, forcing the minor street traffic to turn right, and preventing left turns from the major street. Pedestrian crossings, cycle intersection markings, and an opening in the median facilitates foot and cycle crossings.

Restricted Access Strategies

Local Access Streets and Limited Traffic Zones
Create a primarily pedestrian street or transit and pedestrian street by limiting private vehicle traffic to local deliveries and residents. Local access can be a temporary, periodic, or permanent condition.

Car-Free Zones
Create multi-block areas where vehicles are prohibited, allowing safe and free pedestrian and cycle movement, especially in areas with extremely high pedestrian demand, such as markets or retail areas. Deliveries should be accommodated during off-peak times or on streets adjacent to the car-free zone.

Temporary Closures
Performed by police officers or authorized local groups, temporary closures offer a simple way to provide street space for active uses such as ciclovías, street markets, civic gatherings, and other community events.

8.6 | Parking and Curbside Management

Parking demand far exceeds supply in city centers and commercial streets. Unregulated parking tends to push into inappropriate spaces, blocking sidewalks, cycle lanes, and through-traffic lanes. By providing designated space for critical curbside uses, such as freight loading, and by placing a value on general vehicle parking, cities create a regulated market for parking. A combination of purpose-based zones, time limits, and pricing can make parking and loading significantly less time-consuming, improving safety for all users and reducing lane blockages while freeing large portions of the streetscape for valuable public space uses.

Rome, Italy

Pricing

Metered Parking
Allow a price to be assigned for the use of curbside space by vehicles.

Multispace Parking Meters or Pay-by-Phone Parking
Increase the capacity of the curb compared to designating fixed curbside spaces.

Time-of-Day Parking Pricing
Reduce the number of vehicles cruising for parking, and the time spent by drivers doing so, by charging higher rates during the highest-demand periods of the day or week.

Zones and Designated Spaces

Transit Stops
Construct boarding bulbs or boarding islands to reduce dwell time and permit the use of longer buses on small streets. They also allow the construction of higher-floor stations. *See the NACTO Transit Street Design Guide.*

Long-distance buses dwell for longer periods and require more curbside space. Design to provide more sidewalk space for passengers waiting and boarding.

Loading Zones
Allow taxis, freight, and other private vehicles to load or unload in designated spaces without blocking through motor vehicle, cycle, and transit traffic. Loading zones are especially important near large stores and markets, as well as on streets with commercial activity such as neighborhood main streets and central city streets, and streets with transit routes. Freight loading zones are exclusive to trucks and other delivery vehicles. Truck layover zones, usually in industrial districts, allow curbside use for several hours or overnight.

Taxi Stands
Provide curb space for taxis to queue while waiting to pick up passengers. These can be valuable near major destinations and transit stations to organize taxi hailing.

Vending Zones
Permit vendors using food truck or retail stalls at designated spaces and times of the day. These can be implemented as single stalls, or in long corridors to create a market street.

Car Share Zones
Encourage the use of car sharing to help discourage car ownership.

District-Wide Initiatives

Downtown No-Parking Districts
Reduce vehicle travel to central civic and employment areas that are well-served by transit, walking, and cycling facilities by completely eliminating parking within the district.

Permit Parking
Provide residents of blocks or districts with parking permits, capping parking demand on neighborhood streets, making it easier for residents to find parking spaces, and reducing the use of vehicles for neighborhood-to-neighborhood travel.

8.7 | Speed Management

Vehicle speed is the single most important indicator of the safety of a street. The higher the speed, the higher the crash rate and the injury severity rate. As such, it is imperative to manage vehicle speeds. Introducing high speeds into narrow, constrained corridors may cause traffic injuries and fatalities. While traffic enforcement can help manage speeds, it is not always available. Instead, speed management should be achieved through design complemented by intersection controls and supported by enforcement where possible.

Overview

Speed management lowers the likelihood of severe or fatal traffic injuries by reducing the frequency and severity of crashes. For pedestrians, speed management creates safe conditions for crossing, walking along the corridor, or sharing space with cycle or motor vehicle traffic. For cyclists, lower speed reduces the number of overtaking events, improves visibility and reaction time, and greatly reduces the severity of crashes that do occur.

Low and consistent traffic speed decreases noise and air pollution that result from acceleration and deceleration, while reducing stress for vulnerable road users.

Highway design is very limited, but as speed is lowered, the design palette expands. Speed management strategies include cost-effective, readily implemented techniques for streets of every size, traffic volume level, context, and human activity level.

Operational Techniques

Geometric Traffic Calming Strategies
Reduce speeding by introducing vertical elements such as speed bumps or raised pedestrian crossings, and horizontal elements like curb extensions, pedestrian refuge islands, or lane narrowing, into the streetscape. Comprehensive design techniques use visual and other sensory inputs to signal to drivers that they are entering an interactive, multimodal space, rather than a traffic-only space.

Slow Zones
Combining multiple speed reduction treatments, slow zones, also known as limited-speed zones or home zones, can be implemented in areas with lower speed limits than the rest of the city, such as around schools or residential areas. These should be identified with self-enforcing gateway treatments and signs to alert drivers to the reduced speed limit. *See 6.1: Designing for Pedestrians.*

Roadway and Lane Narrowing
Narrowing lanes and reducing the total amount of space available to vehicles reduces speeding. On one-way streets, excess road width can be repurposed for pedestrian, cycle, and transit facilities. In places with lower traffic volumes, conversion to two-way streets can lower speeds and improve driver attention by requiring negotiation with oncoming traffic.

Signal Progressions
When set to cycle- and transit-friendly speeds of 20–25 km/h, signal progressions can remove much of the incentive to speed. This tool can be applied inexpensively and effectively on almost any signalized street regardless of size, and is especially easy to implement on one-way streets.

Set Speeds to Human Limits

The combination of speed and conflict produces deadly results. The human body's limit to withstand impacts is the critical design parameter for urban streets. Safe walking and cycling require motor vehicle speeds to be set at survivable levels. The systematic way to eliminate fatalities is to eliminate high-speed interactions by:

- Reducing top operating speeds for vehicles
- Eliminating potentially fatal conflicts
- Reducing speeds at conflicts to very low levels

Survivability of a crash is much better below **30 km/h**. Younger and older users and conflicts with larger vehicles require even lower speeds. For the most vulnerable users and for heavy vehicles, there might be no survivable impact speed.

Reduce turning speeds at pedestrian crossings to **10 km/h**, and drop top speeds to **30 km/h** where cycles share a lane with motor vehicles. On streets where the interaction between people and motor vehicles is limited to frequent controlled crossings, speeds of **40 km/h** can be permitted.

Rather than designing streets for speeds higher than the speed limit, target speeds should be set low enough that even non-compliant drivers will present minimal risk to pedestrians.

Permeability
All streets must be easy to cross and should be designed to encourage safe crossings. Planned crossing locations must be frequent to account for the time spent by people walking to a crossing. On multi-lane streets, reduce the distances between crossing points, and reduce the distance (number of lanes) between pedestrian refuges, especially on streets that lack traffic controls.

Legibility and Uniformity
Safe streets can be read by their users—geometry, materials, and roadway markings communicate critical information, including appropriate speeds and where to expect other people and vehicles.

Reduced speeds expand the use of peripheral vision by drivers, widening the visual cone and increasing the chance of seeing people crossing.

Organize Large Streets, Share Small Streets
Large streets call for dedicated space for each user. On small streets or intersections with very low speeds, people can mix with vehicles safely. The appropriate tools of traffic operations and geometric design should be applied, depending on the level of connectivity and traffic volume on the street.

Accessible Streets are Safe Streets
Streets must provide accessible paths that meet the fundamental movement needs of all users, especially pedestrians in wheelchairs, the visually impaired, and people with strollers or baby prams. Inaccessible streets force the most vulnerable users into unsafe conditions.

8.8 | Signs and Signals

Signs and signals assist with control strategies for intersections and crossings. These intersection control techniques should focus on the goal of safely moving people who are walking, cycling, using transit, and driving, and on reducing overall person delay rather than vehicle delay. Signals directly impact the quality of the transportation system, and the operation of a city's traffic control system should closely mirror the city's overall transportation policy goals and objectives.

Amsterdam, The Netherlands

Portland, USA

Signs

Stop and Yield Control Signs
Stop, all-way stop, and yield signs are applicable to lower-volume urban intersections. They should always be implemented in a way that promotes safe pedestrian crossing. If signs alone are insufficient to create safe crossings, consider geometric measures before signalizing the crossing.

Speed Signs
Speed-limit signs are applicable to all urban streets, reiterating overall citywide speed limits as well as specific permissible speeds for shared spaces, laneways, or other slow zones.

Curbside Signs
Curbside signs communicate rules related to parking, loading zones, restricted access, and other curbside management strategies. In some jurisdictions, signs are legally required for enforceable cycle lanes, transit stops, or transit lanes. Use overhead signs only on multilane streets.

Signals

Signals work in tandem with geometric design to create a highly functional multimodal street with safe crossings and intersections. Signal timing influences delay, compliance, speed, and mode choice.

Fixed signal phasing is preferable in urban areas, providing predictability and consistent opportunities to cross streets. Actuated signals and beacons are applicable where pedestrian volume is very low and speed management is not sufficient to create safe crossings.

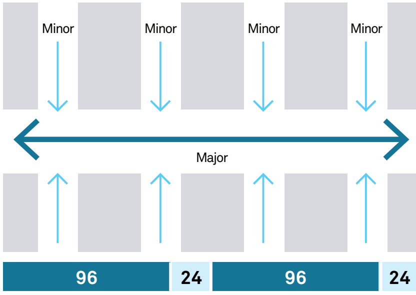
Signal timing should be managed differently at peak and off-peak times, adjusted to meet different levels of modal activity and different goals throughout the day. *See 9.4: Design Hour.*

Signals should not be considered in isolation, but rather as a system of intersections. Coordinating the timing of crossing corridors is a challenging but high-value traffic management process.

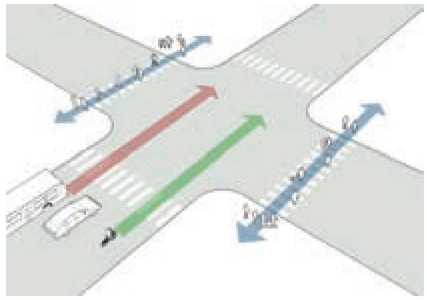
Traffic signal timing with insufficient time for pedestrians to cross a street or long signal cycles that increase waiting times are likely to create an unpleasant or unsafe street, and may discourage walking. Significant delays may cause street users to ignore the traffic signal.

Signal Progression

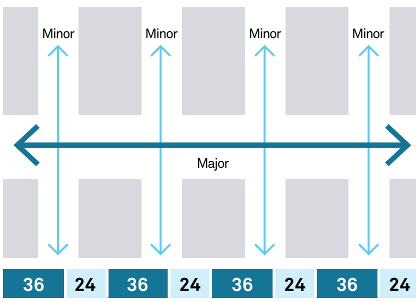
Signal progressions, or green waves, determine the pace of urban streets. Coordinated signal timing synchronizes traffic movements along a corridor and manages the progression speed. A progression speed based on realistic transit and cycle travel speeds, usually in the range of 20-30 km/h, optimizes cycle and transit movements and removes much of the incentive for vehicles to speed. Depending on block length, this progression speed may also synchronize with walking speeds, typically 1 –1.5 m/s.



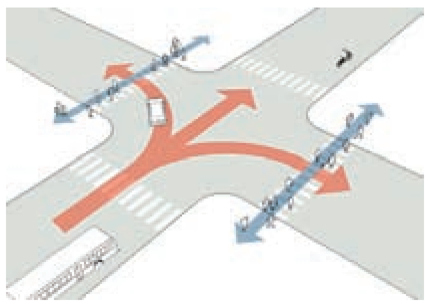
Long cycle lengths (in seconds) should be used in limited cases as they can divide neighborhoods and make walking or crossing the street frustrating and prohibitive.



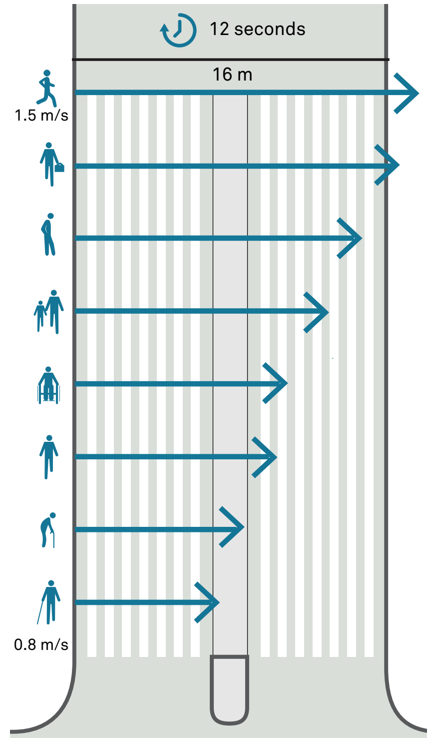
Multimodal Head Starts, Interval 1. Pedestrians, transit, and cycles are given a head start as they enter the intersection, usually 6 seconds or more.



Balanced cycle lengths (in seconds) reduce waiting times in all directions and create crossing opportunities at closer intervals.



Multimodal Head Starts, Interval 2. Through and turning traffic are given the green light, as pedestrians, cycles, and transit continues, with turning traffic yielding to pedestrians.



Set signal cycles to accommodate all users. Signal cycles must allow pedestrians moving at different speeds to safely cross the width of the street or get to a refuge space. The graphic shows a 16-m street and the distance people can walk in a 12-s signal cycle.

Signal Cycle Lengths

Though often invisible to the public, traffic signal lengths have a significant impact on the quality of the urban realm and shape how safely pedestrians, cyclists, and transit vehicles interact.

Short Signal Cycle Lengths

For most modes, short signal cycles, usually 60–90 s, minimize delay in a complex network environment. Shorter signal cycles reduce wait times in all directions and create crossing opportunities at closer intervals. Signal phases must account for pedestrian crossing time based on street width and realistic walking speeds.

Long Cycle Lengths

Signal cycles over 90 s can make large avenues into barriers that separate neighborhoods and can make crossing the street or walking short distances frustrating or prohibitive. Long cycles should only be used if necessary to provide pedestrian crossing time on very wide streets.

Signal Phasing

Simple Phasing

Two-phase signals are most appropriate at simple, small intersections where geometric design creates low turn speeds. Use pedestrian countdown signals and set clearance intervals for slow pedestrians.

Lagging Left Turn Phases

Turns across traffic present risks to all users on multilane two-way streets. Eliminate left-turn conflicts by providing a dedicated left turn phase after the through vehicle phase.

Leading Pedestrian Intervals (LPIs) and Leading Cyclist Intervals

Provide pedestrians and cyclists a head start before turning vehicles, improving safety and comfort. Time LPIs, at minimum, for a person walking 1.2 m/s to reach the center of the roadway, occupying the crosswalk. Use cyclist signals to provide a leading cyclist interval at the same time.

Multimodal Head Starts

Improve safety and reduce delay for pedestrians and through-moving vehicles, including transit and cyclists in dedicated lanes, by holding turning vehicles at the start of the through phase similar to an LPI. Turning vehicles receive a red arrow, followed by a flashing yellow arrow to indicate the need to yield while turning.

Pedestrian-only/ Cyclist-only Phases

Where pedestrians or cyclists cross diagonally—in complex geometry, high turn volume locations, or on one-way streets with turn lanes—a full-length pedestrian-only phase provides a dedicated pedestrian crossing, but may increase delay or decrease compliance by all users.

Transit Priority Phases

Some active transit signal priority techniques, including transit-only through or turn phases, require dedicated phases.


3A Nordhavn St.

9

Design Controls

Design controls determine the physical design of the street. Far from neutral inputs, they are tools that planners can use to ensure that streets are safe and accessible to all users. They shape the street in fundamental ways and influence user behavior, including speed and choice of modes.

Use design controls to proactively manage multimodal operations, creating safe and inviting streets that reflect community priorities.

Design controls commonly used in engineering include design speed, design vehicle, design hour, and design year. This chapter outlines how to set these attributes, often used as an input in formulas or models in the design process, in a way that produces safe urban streets.

By intentionally setting these controls to produce a pleasant street environment, practitioners can counteract the tendency to create faster and larger streets. Planning and design controls should be based on larger policy goals and contextual considerations. Once planning and design controls are established, uphold them throughout the design process, allowing only a minimal exceptions.

Copenhagen, Denmark

9.1 | Design Speed

Design speed is the target speed at which drivers are intended to travel on a street, and not, as often misused, the maximum operating speed. Actively designing for target vehicle speeds is critical to safety. Changing a street's design results in behavior changes. Practitioners must manage speeds by setting clear expectations for drivers. The level of walking, cycling, and activity, as well as the degree to which modes are mixed or separated, is the critical determinant of a safe vehicle speed. Reducing vehicle speeds opens up a range of design options that allow a street to function and feel like part of a city, rather than a highway. Designers must not use highway-based design speed practices in urban areas. Instead, they must be proactive in limiting vehicle speeds, providing frequent pedestrian crossings, limiting the number and width of lanes, using low speeds for turn radii, and introducing trees and furnishings.

Conventional practice designates a design speed higher than the posted speed limit to accommodate driver errors. But, in fact, this practice only encourages speeding and increases the likelihood of traffic crashes, fatalities, and injuries.

A proactive approach selects a target speed and uses design to achieve that speed, guiding driver behavior through physical and perceptual cues. These cues include narrower lane widths and tighter curb radii, signal progressions, and other speed management techniques. Using lower design speeds in street design reduces vehicle speed and speed variation, providing safer places to walk, cycle, drive, and park.

The design speed for urban areas should not exceed **40km/h**, with exceptions for specific corridors. To determine appropriate design speeds other than **40km/h**, consider the multiple safety, health, mobility, economic, and environmental goals.

Speed, Severity, and Frequency

The most effective way to reduce fatalities and severe injuries on streets is to reduce vehicle speeds.[1] The vast majority of people killed in traffic are struck on streets with high speeds, even though those streets represent only a small portion of a city's total activity and movement.

Speed is the primary factor in crash severity and the likelihood of a crash occurring. Increased speeds result in longer reaction times, a narrower cone of vision,[2] and increased stopping distances while providing less time for others to react. An increase in average speed of **1 km/h** results in a **3%** higher risk of a crash and a **4–5%** increase in fatalities.[3]

Speed differential is also a critical component of safety. People walking or cycling are placed at great risk when faced with motor vehicles turning across their paths, at a speed much faster than their own. Keeping design speeds low on streets where cycles, cars, trucks, or buses share a lane or street reduces crash risk, and the likelihood of serious injury or death. A design assumption that modes are separate can become dangerous when user expectations vary. The safest streets match the degree of mixing with an expectation of mixing, using design to communicate the specific conditions.

Target Speeds and Context

10

10 km/h. A shared street or similar environment mixes users at very low speeds, at most 15 km/h, with both activity and geometry keeping speeds low.

20

20 km/h. Residential streets should allow play and social activity in the street. Use a target speed of 20 km/h to support safe speeds and implement speed management strategies if higher speeds exist.

30

30 km/h. Use speed management techniques to limit speeds to 30 km/h or lower on streets with a high degree of activity in all modes and high demand for pedestrian crossings. This is a safe speed for cycles to ride in mixed traffic and presents low risks to people walking along and crossing the street. This condition is often applicable on neighborhood main streets and large central city streets.

40

40 km/h. At this speed, designate frequent signalized pedestrian crossing points, and include cycle tracks based on the overall network. Use street geometry and speed management tools to physically and visually signal to drivers that speeds should not exceed 40 km/h.

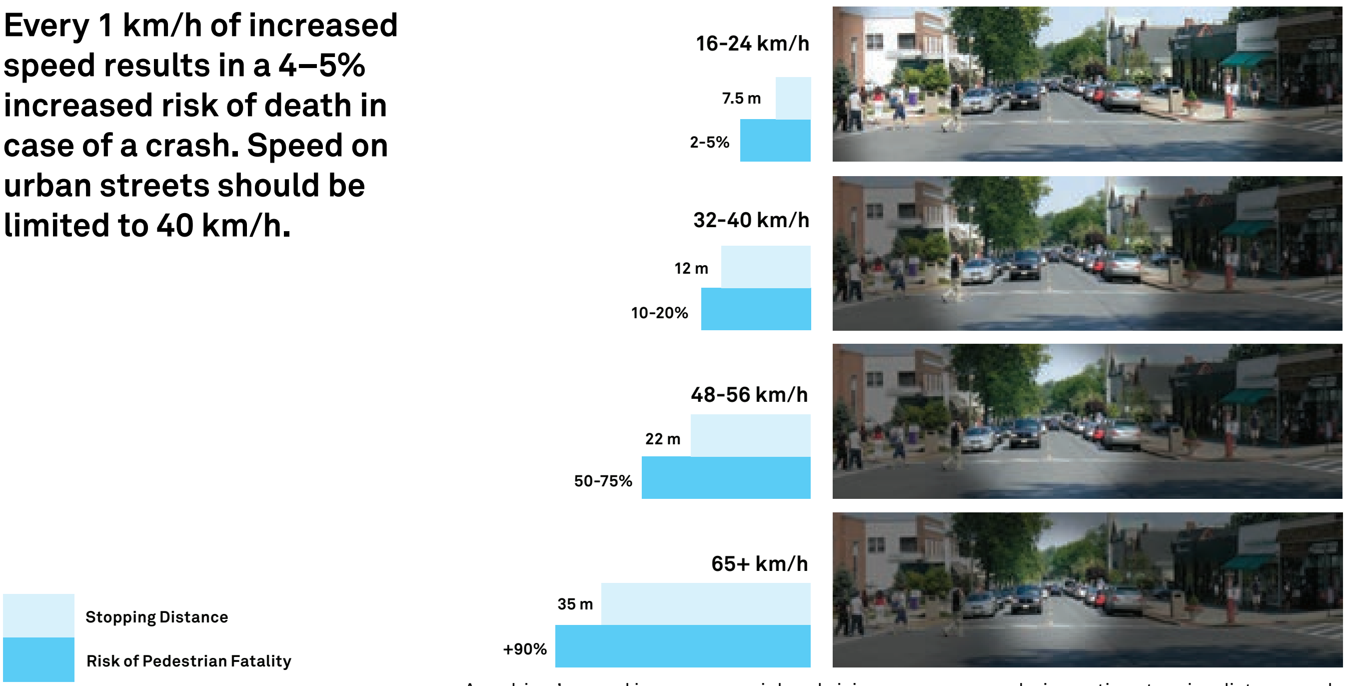
50

50 km/h. On some large streets with cycle tracks, large sidewalks, medians, and frequent signalized intersections and pedestrian crossings, it is possible to accommodate traffic speeds of 50km/h, using signal progressions, trees and furnishings, and 3-m wide lanes to discourage speeding.

60

60 km/h. Speeds of 60 km/h or higher are not safe on urban streets. Extreme care must be used to protect vulnerable users without destroying the social and economic functions of the street or disrupting the walking network.

Every 1 km/h of increased speed results in a 4–5% increased risk of death in case of a crash. Speed on urban streets should be limited to 40 km/h.



As a driver's speed increases, peripheral vision narrows severely, impacting stopping distance and risk of pedestrian fatality. *See 1.5: Safe Streets Save Lives.*

Critical Guidance

Do not design streets for speeds higher than the posted limit.

Establish the target speed based on all users and not just drivers. Develop a realistic assessment of the way the street is used, and account for the immediate context and municipal safety goals. Design streets to constructively guide driver behavior, discouraging speeds above the target speed and promoting the safe mixing of multiple modes.

Set speed limits at the target speed if possible. If statutory speed limits are higher than safe urban speeds, set the design speed below the speed limit. Make speeding uncomfortable through design and operational techniques.

Target speeds must, in all circumstances and on all streets, allow people to walk along and to cross streets without substantial risk of being injured by vehicles. They must provide drivers with adequate time and distance to avoid striking pedestrians crossing the street.

Do not use target speeds of **60 km/h** or higher. These speeds endanger safety on urban streets and are reserved for limited-access highways.

Recommended Guidance

Desired vehicle speed should be achieved by choosing street sections that encourage safe speeds. Keep the total number of through-traffic lanes to a minimum. Choose a small radius for turns, use signal timing to promote low speeds, and apply speed management techniques where the street section does not prove to be sufficient. *See 8.7: Speed Management.*

Where speeds greater than **40 km/h** are allowed create a physical separation between vehicles and vulnerable users such as pedestrians and cyclists. Parked vehicles, built medians, buffers, or other vertical elements may be used as a barrier, though frequent opportunities for safe crossing must be provided. These should be ideally located at intervals of 80–100 m, and not more than 200 m.

Limit the speed differential within and between modes. If people walk in the same space as motorists, use a speed of **10–15 km/h**. If pedestrians routinely cross the street mid-block, away from formal crossings, select a target speed of **20 km/h** or less. If cyclists are mixed with motorists, but pedestrians do not share the same space, use a speed of 30 km/h or less, even at low traffic volumes. These speeds are also consistent with bus traffic.

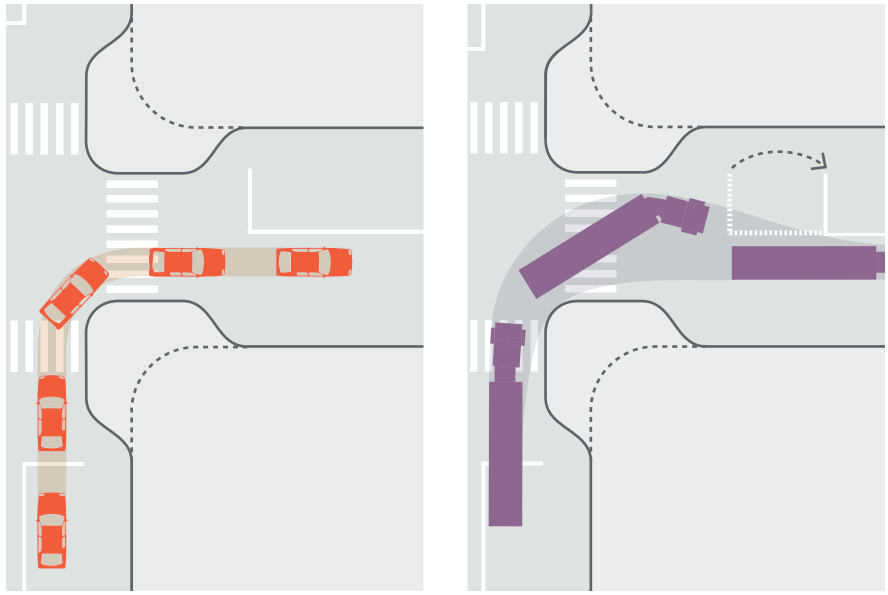
Default design speeds based on street types or zones can be established as a starting point. Above 40 km/h, the use of specific engineering action, such as signalization and other conflict management techniques, is recommended to create basic conditions for safe use across all modes.

Urban streets can rarely accommodate pedestrians and cyclists safely when prevailing speeds are 60 km/h or higher. If speeds cannot be reduced, high-quality walking and cycle facilities should be provided at grade, with robust protection such as parallel parking, trees, and medians. Do not use techniques that discourage pedestrian activity and destroy or limit the street's economic functions and social activity.

Foster a safety culture. Publicize and regulate the speed limit with signage, markings, and public information campaigns, and routinely enforce the speed limit. Full-time electronic enforcement by radar-enabled license plate readers or speed cameras and moderate fines are more effective and equitable than manual enforcement with high fines.

9.2 | Design Vehicle and Control Vehicle

Designers use a design vehicle or design user to set characteristics of the roadway, transitway, sidewalk, and cycleway. Designing for comfortable use by the occasional large truck often results in overly wide roads or high-speed turns by cars, and opportunities are lost to create space for other, more-frequent users such as pedestrians. Select a design vehicle—a routine user for whom the street is designed—as well as a control vehicle—one that only occasionally uses the street — to prevent the overdesign of a facility. Safe design means tailoring elements for the most vulnerable street user rather than the largest possible vehicle.



Turning Radii. Accommodate the different turn radii of frequently present Design Vehicle (left) and the occasionally present Control Vehicle (right) at different speeds, using geometric techniques such as advance stop lines, without increasing the turn radius and speed of the Design Vehicle.

The design vehicle is the least maneuverable vehicle that routinely uses a street or a facility. This could be a pedestrian in a wheelchair, a cyclist on a cargo bike, a delivery truck, or a transit bus, depending on the type of facility and its user volumes. The choice of design vehicle directly affects the design of the street, impacting the safety and comfort for each user. In particular, intersections and lane transitions are designed for comfortable use by the design vehicle.

The control vehicle is the least maneuverable vehicle that is ever planned to use a street, but potentially at very low speeds or with multipoint turns.

Critical Guidance

Use both a design vehicle and a control vehicle to determine intersection turn radii and lane widths, understanding that the control vehicle is an infrequent presence on the street and can be accommodated with temporary interventions such as flaggers or road closures, and may use multiple lanes and mountable street elements to make turns.[4] Use advance stop bars or other elements to accommodate movements by design vehicles. Do not widen existing intersections to permit larger vehicles to turn.

For pedestrian facilities such as sidewalks, ramps, and crossings, key design vehicles include a person using a wheelchair or a small group of people walking together. In some cases, the design case will be two such groups passing one another. A large group, such as a class of children, can be used as a control vehicle, particularly for pedestrian islands.

For cycle facilities, use cargo bikes or, where present, cycle rickshaws as the design vehicle, especially when designing cycle lane curves, transitions and grade changes, as well as confined areas.

For transit facilities including transitways, transit lanes, and mixed-traffic lanes with buses, use the typical transit vehicle as a design vehicle, but only for movements used by transit. Since transit routes do not turn at every intersection, but may use off-route streets to turn around, coordinate with transit operators to determine transit turn locations and design these turns accordingly.

For motor vehicles, choose the smallest turn radius and curve that accommodates routine or frequent use. Design for very low turning speeds of no more 10 km/h. Small corner radii at intersections also shorten pedestrian crossing distances and save signal time. *See 6.6.5: Corner Radii.*

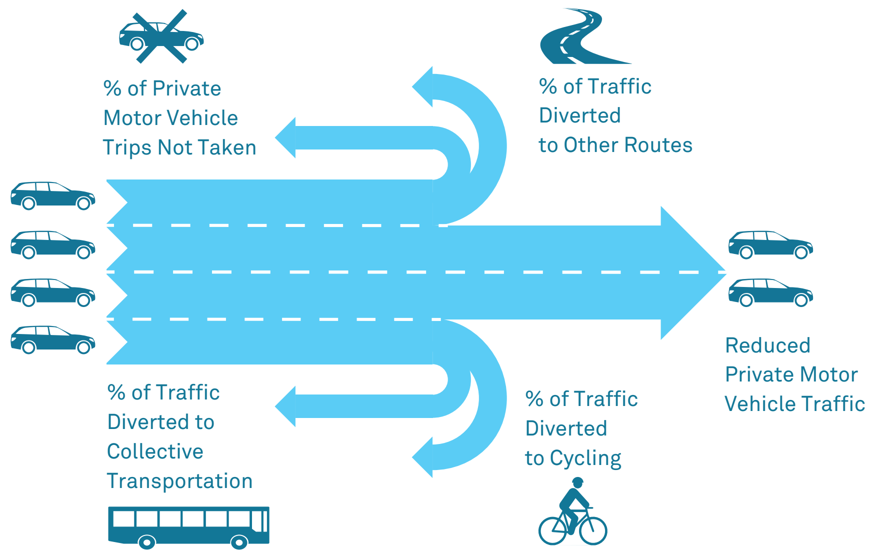
Recommended Guidance

Where emergency vehicles are much larger than the design vehicle, they can be permitted to make turns by using all areas of the right-of-way, including mountable corner islands or median tips, and portions of the sidewalk, where necessary. Flexible bollards, mountable curbs, and other devices facilitate emergency movements. Work with emergency responders to reduce the size or turn radius needed by newly purchased vehicles.

Larger vehicles may be restricted from certain roads based on context or street typology in order to allow the use of a smaller design vehicle. While restrictions on large vehicles are often made by necessity in central areas or historic districts, large vehicles may also be restricted to permit safer, human-scale street design on newer streets. Larger vehicles may be permitted at certain times, or deliveries may be made by hand truck or cargo cycle. These methods can prevent the choice of excessively large design vehicles. *See 8: Operational and Management Strategies.*

9.3 | Design Year and Modal Capacity

Cities must make investments that consider the life of major infrastructure investment and account for anticipated future growth and development. Yet, traditional traffic forecasting substantially overestimates traffic growth. Even as trends show otherwise, many transportation models still assume an upward trend in traffic demand, accepting more vehicle kilometers traveled as inevitable. Instead, cities must link design capacity for each mode to the desired mode split and activity on a street. Capacity should be measured based on total person capacity rather than vehicle level of service, using vehicle capacity to understand operational decisions.



Traffic Evaporation. Research shows that when road capacity is shifted to other modes, some peak-period traffic disappears from the network. Drivers shift to other modes, make trips at other times, or shift destinations.

Street design should be goal oriented and policy driven, with design year decisions supporting these goals. City transportation policies often prioritize walking, cycling, and transit. Many set explicit mode share targets to reduce dependence on single-occupancy vehicle use. Meeting these aggressive goals and targets will require a shift in both infrastructure investment and travel behavior.

Design year is applied to a project as the future conditions it should accommodate. If increased traffic is assumed, a self-fulfilling projection of increased traffic will be established. Conventional scenarios may also be at odds with community goals and preferences. For example, a 2% annual growth rate in vehicle volume represents a doubling of vehicles within 35 years, or less than two generations.[5] Most cities and neighborhoods cannot afford such growth.

Traffic Evaporation and Induced Demand

Induced Demand. Travel in a given mode increases when it gains advantages in comfort, cost, travel time, or perceived convenience. Increased vehicle capacity on a street or network can result in increased vehicle travel, displacing other activity and slowing transit.

Traffic Evaporation. In urban areas, private vehicle volume decreases when road capacity is shifted to transit, cycles, and walking. This is known as *traffic evaporation*. Research shows that when road capacity is shifted to other modes, some vehicle traffic is absorbed by parallel routes, but drivers also shift to other modes, make trips at other times, or shift destinations. It has been shown that traffic disappears at a rate of 11%.[6]

Reducing VKT. To reduce Vehicle Kilometers Traveled (VKT), construct streets that include dedicated transit facilities, comfortable sidewalks, cycle facilities, and compact development. Dedicated transit facilities help shift movement from private vehicles and taxis to higher-efficiency collective transport, increasing the capacity of the street to move people while decreasing VKT.

Modal Capacity and Mode Splits

Appropriate modal capacity helps achieve a desired mode split. Build new streets in large developments assuming that most short trips will be made on foot or by cycle, including access to transit.

On existing streets with new development, implement operational measures that change vehicle capacity, such as signal timing or lane assignments, only after a new development's traffic impacts are known rather than relying on self-fulfilling predictions.

Cycle facilities often experience substantial growth in use when high-comfort facilities are provided. Account for growth where expected.

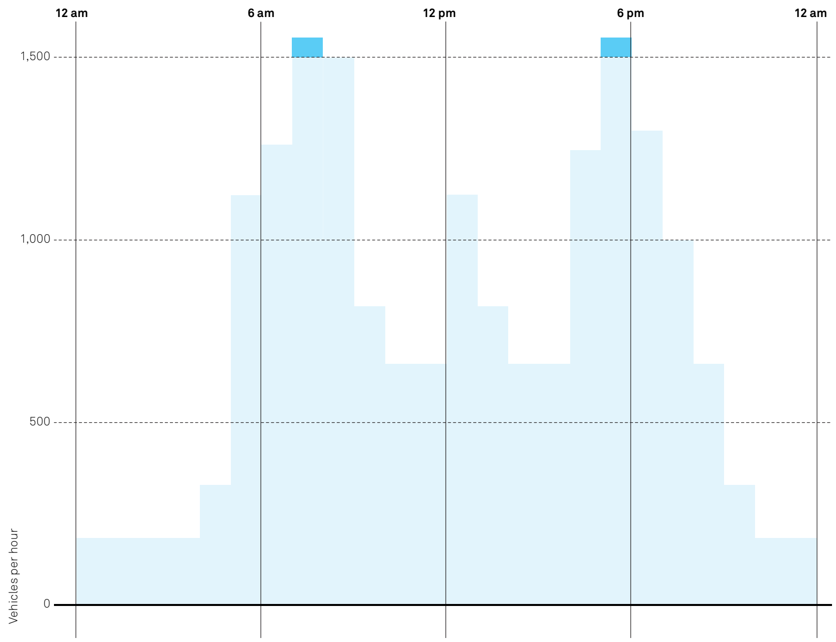
Capacity and Development Review

Development review is a critical juncture for street design, when long-term decisions are made. Use existing transit capacity and opportunities for increased capacity to determine where new development is desirable. Estimate the person and freight capacity needed. Setting a desired and realistic mode split based on transit connectivity and proximity to destinations helps to determine the facilities needed to achieve an equitable modal mix.

9.4 | Design Hour

Streets function differently at different times of day, at different times of year, and over longer periods of time. The pace and flow of life varies in each city as does the use of public streets. Streets expand and contract with people, vehicles, vendors, cafés, markets, and crowds throughout the day and week.

Design streets to provide comfortable capacity during a typical hour of the day, instead of just the peak hour. The typical hour is often the average between activity levels during peak, late night, midday, and weekend hours. This allows planners to balance safety with the needs and functions of the street at different times.



Analyze peak points of stress within the overall context and changing use of the street.

Design Hour, or activity levels during an hour, is used to determine the appropriate street dimensions. The traditional practice of using a single peak hour volume and projected volume increases allows traffic volumes to dictate the construction of costly infrastructure, without determining how much traffic is desired on a street.

Rather than creating infrastructure to be used for just a few hours each day, consider the average activity levels of a street by analyzing multiple hours for a clearer picture of demand. Building unnecessary capacity may be expensive. The cost varies widely based upon land ownership, terrain, and prevalence of other variables.

By proactively setting the capacity for motorized vehicles, Design Hour can also be used to guide the amount of traffic a street will accommodate, and organize the street so that it can support a balance of many different users.

Critical Guidance

Base operational decisions on unbiased quantitative measures that consider overall community metrics and the many functions a street must serve, including safety, supporting local businesses, providing access to jobs and services, and environmental targets. *See 3: Measuring and Evaluating Streets.*

Recommended Guidance

Expand the Design Hour analysis to include the various peak hours throughout the week for all users. Analysis might include a morning peak, midday peak, afternoon peak, and weekend peak hour. Study these peaks to obtain a more nuanced understanding of travel, resulting in a design better suited to the actual street usage.

Account for all street uses over 24 hours and 7 days. This includes rush hour commuting in all mobility modes, evening strolling, weekend markets, lunchtime dining, and commercial deliveries. Mapping these static, mobile, existing, and expected activities provides a temporal snapshot of the street that can be used in design.

Use person-trips, rather than vehicle-trips, to determine capacity. Trip generation manuals that consider only vehicle trips, or rely on small samples from suburban locations, should be avoided.

Transportation demand management describes programs that seek to shift travel mode, typically away from single-occupancy vehicles. People are encouraged to take transit, walk, cycle, not make the trip, combine trips, or travel at different times of day. These programs are more cost-effective than capacity expansion. *See 8: Operational and Management Strategies.*

AM Peak: Signals are adjusted to accommodate rush-hour traffic during the peak hour, metering traffic to prevent gridlock.

Midday: Downtown pedestrian volumes reach their peak intensity at lunch hour.

Evening: Traffic volumes begin to dip after rush hour, while pedestrian traffic in certain areas rises.

C

Street Transformations

Langhans Galerie Praha
LANGHANS
KINO
LANGHANS GALERIE
PĚŠÍ ZÓNA
MHD
VOZIDLA SE SOUHLASEM
MČ PRAHA 1
24
8346

10

Streets

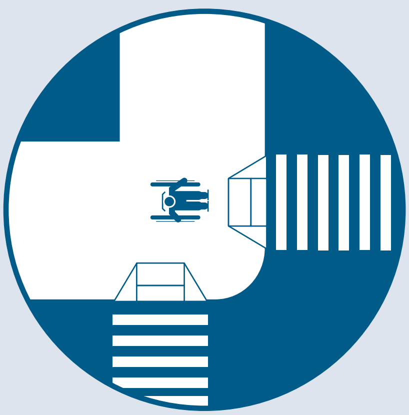
Every urban street is a unique and evolving organism, and every city has streets across a broad spectrum of contexts. Designing for great streets requires clever and careful balancing of the many demands and activities throughout the day. Streets energize social and economic life. They provide spaces for physical activity. They can be our front yards and living rooms, our parks or nightlife destinations, and our essential circulatory system. Streets must provide at every scale for the many people walking, cycling, riding collective transport, driving, making deliveries, selling goods, or simply stopping to take a breath. Above all else, streets are places for people, and a city cannot work without human-centered streets.

This guide shifts from a system of functional classification of street types to a context-based approach to street designs.

Prague, Czech Republic

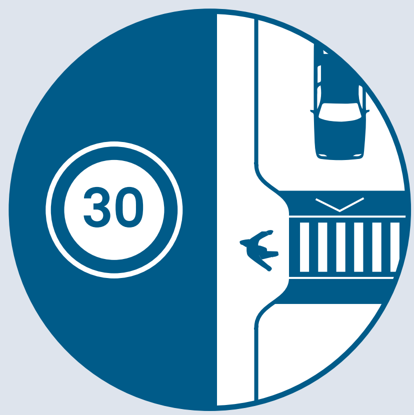
10.1 | Street Design Strategies

Use the following street design strategies to support the key principles outlined in Chapter 4: Designing Streets for Great Cities, and in conjunction with Section 11.1: Intersection Design Strategies.



Ensure Universal Accessibility

Ensure streets serve our most vulnerable users, particularly seniors, children, and people with disabilities. Provide accessible, safe, well-lit, and dedicated facilities. *See 6: Designing Streets for People and 6.3.8: Universal Accessibility.*

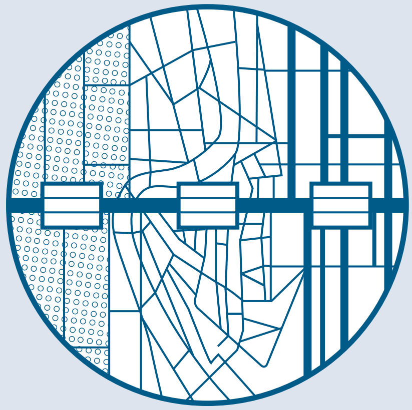


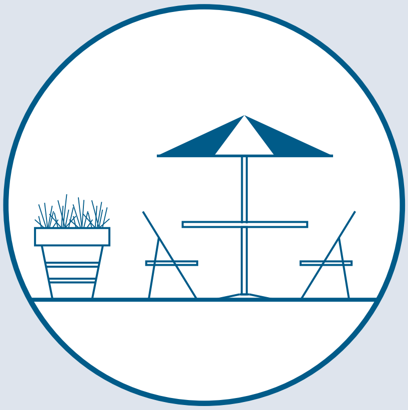
Design for Safe Speeds

Ensure safe design speeds through narrow travel lanes, tight corner radii, and other speed reduction measures that help reduce exposure and risk for vulnerable users. *See 6.6.7: Traffic Calming Strategies; 8: Operational and Management Strategies; and 9: Design Controls.*

Reconfigure the Space

Change geometries to prioritize active and sustainable mobility choices. Provide dedicated facilities that prioritize pedestrians, cyclists, and collective transport use. *See 6: Designing Streets for People.*





Accommodate Diverse Uses

Ensure efficient and diverse uses of streets by providing spaces for social interactions and gatherings, cultural activities, and commercial uses. Incorporate green infrastructure strategies wherever possible. *See 6.8: Designing for People Doing Business and 7.2: Green Infrastructure.*

Develop Context-Driven Solutions

Design streets that are informed and influenced by their place in the network, proximity to destinations, adjacent land use, and density. *See 5: Designing Streets for Place.*

Act Now—Start Somewhere!

Move curbs, change alignments, reclaim space, and redirect traffic. Use a phased approach for major redesigns, consider interim design solutions, and identify areas of political and financial support. Find somewhere to start the transformation, and act now! *See 2.7: Phasing and Interim Strategies.*

10.2 | Street Typologies

Every city must identify the range of street typologies it encompasses. To ensure that new street designs are suitable for the given context, existing streets must be documented and analyzed as part of the comprehensive public space network.

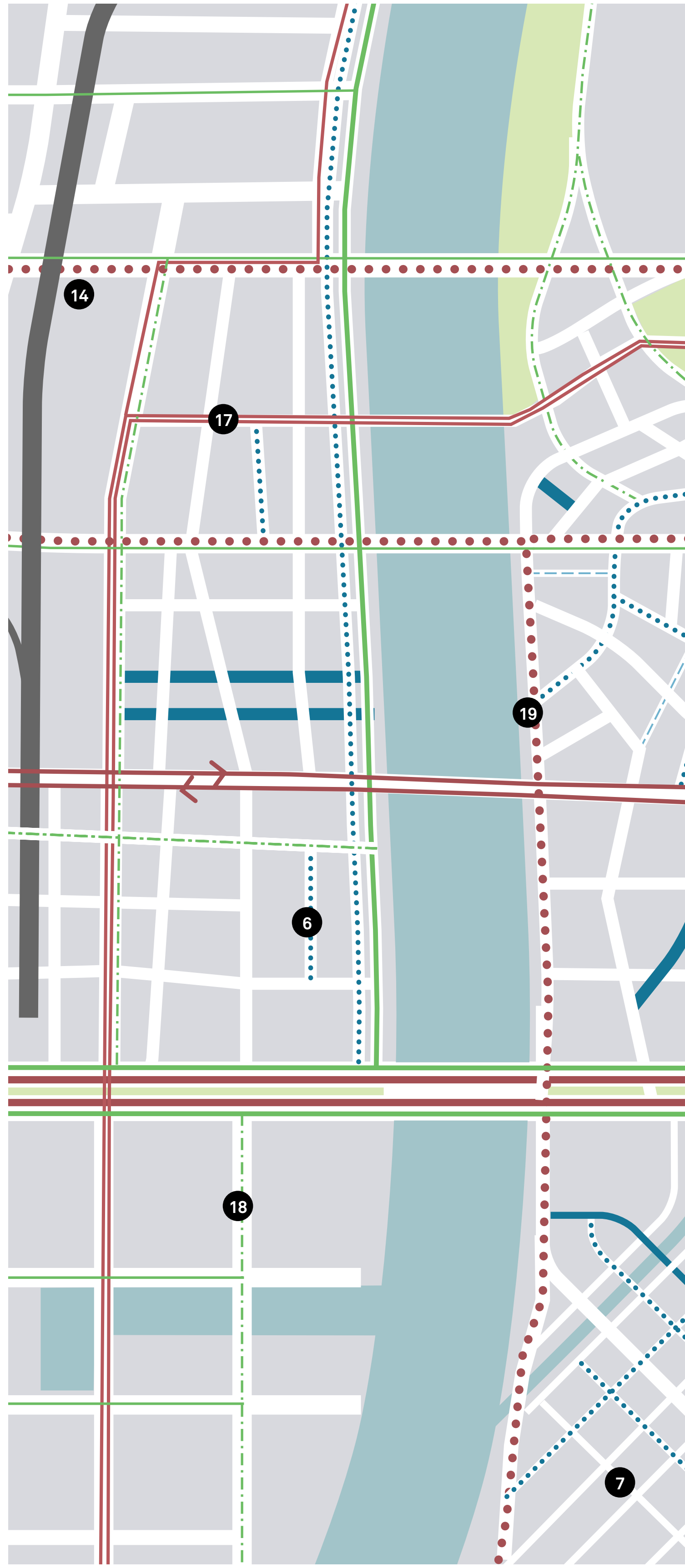
Evaluate each street project to balance the needs of different transportation modes within the given context and culture. Ensure the designs serve social, environmental, and economic needs and functions.

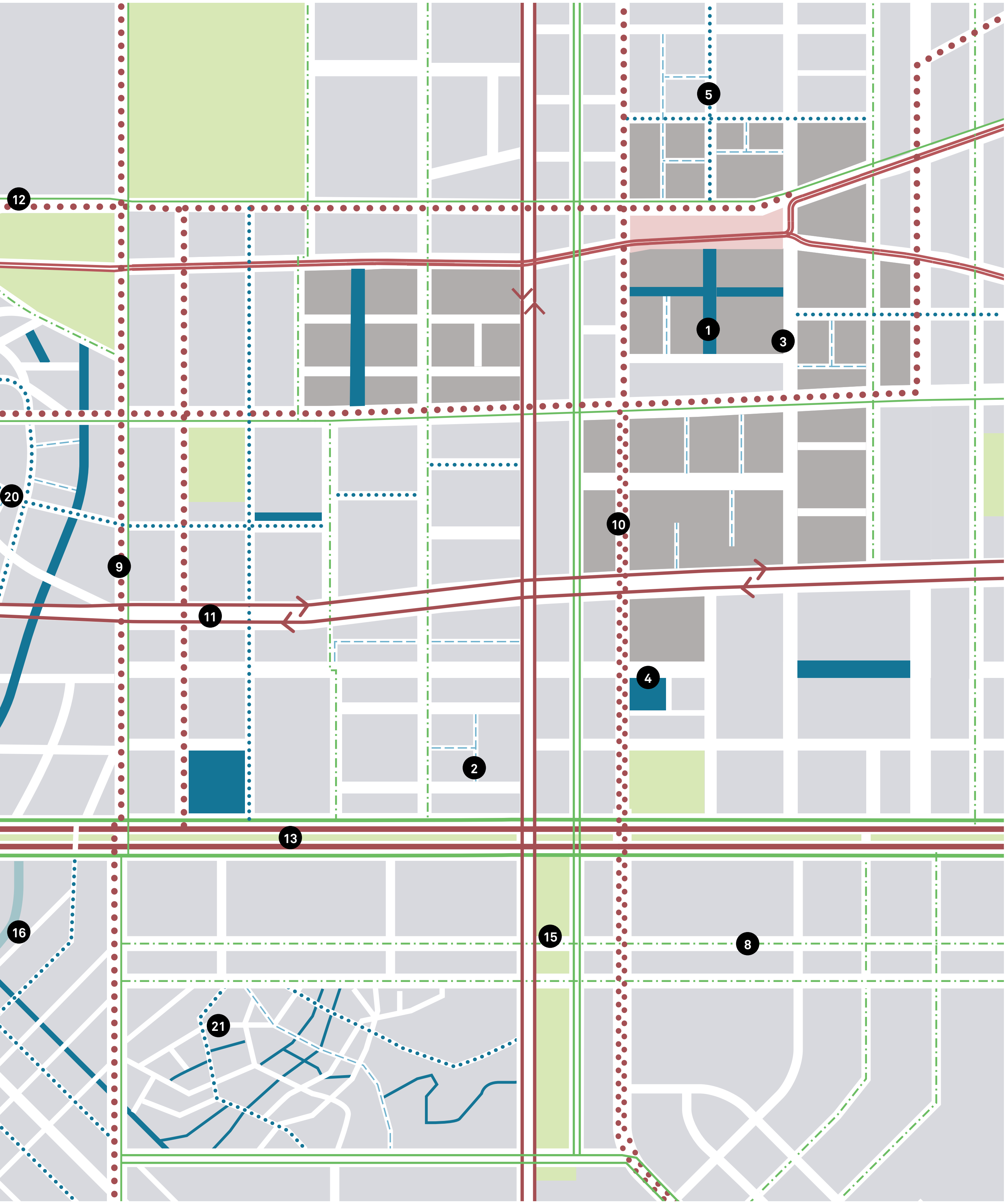
Use the guidance in this chapter to identify opportunities for street transformations. The samples included here are placed in context to each other in the adjacent maps to help illustrate how different street types can work together to form a comprehensive network.

Create a similar map for your local context and identify the types that exist today, and those that are desirable for future urban conditions. Your city map may include the street types shown in this map such as:

1. Pedestrian-Only Streets
2. Laneways and Alleys
3. Parklets
4. Pedestrian Plazas
5. Commercial Shared Streets
6. Residential Shared Streets
7. Residential Streets
8. Neighborhood Main Streets
9. Central One-Way Streets
10. Central Two-Way Streets
11. Transit Streets
12. Large Streets with Transit
13. Grand Streets
14. Elevated Structure Improvements
15. Elevated Structure Removal
16. Streets to Streams
17. Temporary Street Closures
18. Post-Industrial Revitalization
19. Waterfront and Parkside Streets
20. Historic Streets
21. Streets in Informal Areas

See Appendix C: Summary Chart of Typologies Illustrated.

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8
21

10.3 Pedestrian-Priority Spaces

Pedestrian-priority spaces play a prominent role in shaping a walkable, accessible, and enjoyable city. They provide places for people of all ages and abilities to use the city without competing with other modes of transportation.

These spaces encourage people to move at their own pace and provide facilities that invite people to stop, stay, and spend time. They provide a space of relief in dense urban areas, activate underutilized spaces, and boost the local businesses.

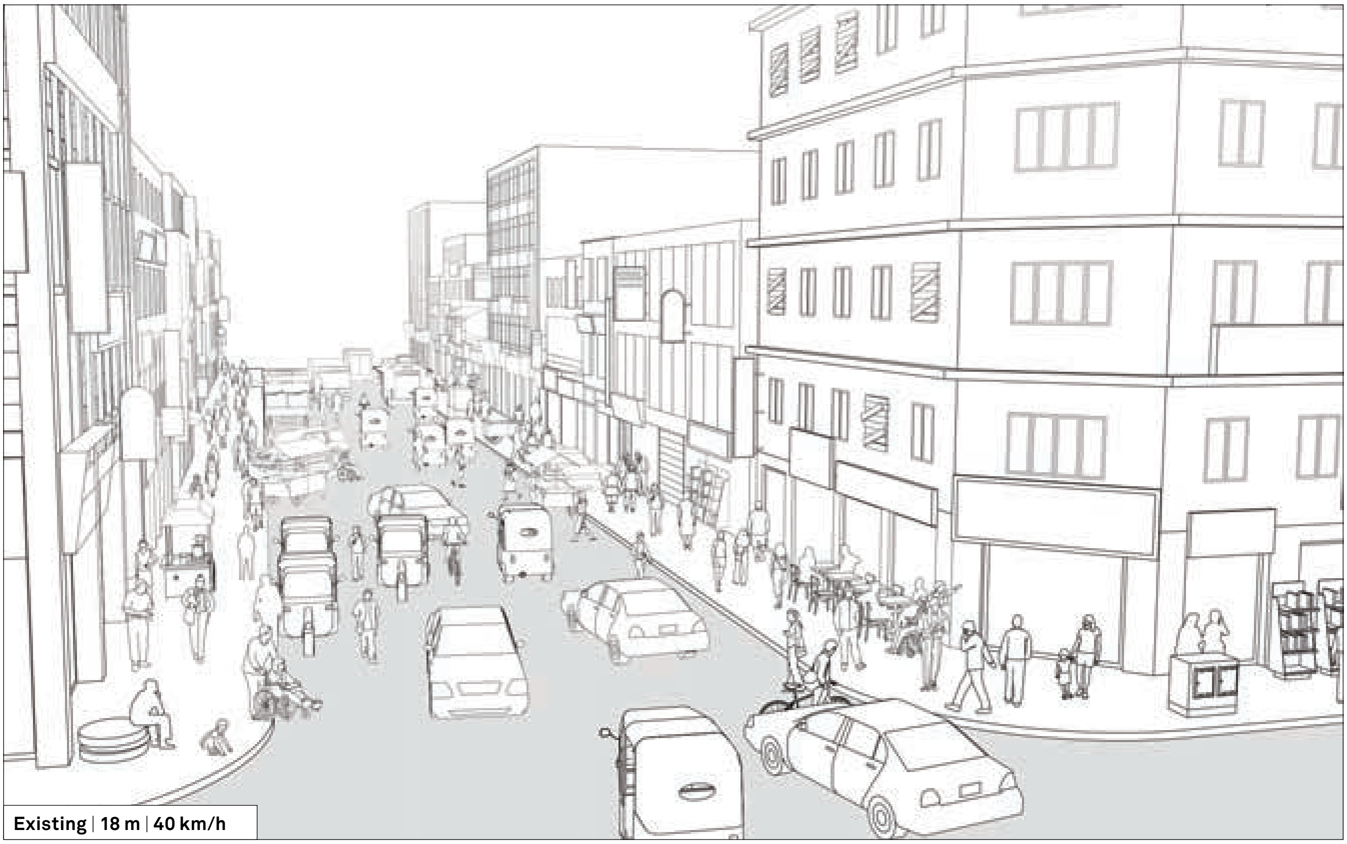
When lined with commercial activity and supported by high volumes of foot traffic, pedestrian-priority spaces may allow businesses access for loading and deliveries at limited times. In some cases, smaller lanes or alleys support local vehicular access at very slow speeds.

Whether they are small plazas or pocket parks, narrow lanes or large shopping streets, pedestrian-priority spaces operate as a part of the city's larger network of streets, parks, and public places to provide a comprehensive network of quality public open spaces, and a variety of urban experiences.

Pedestrian-priority spaces should be equitably distributed throughout all neighborhoods of the city, offering opportunities for social interaction, active recreation, healthy living, and an improved quality of life.

Ho Chi Minh City, Vietnam

10.3.1 | Pedestrian-Only Streets | Example 1: 18 m



Pedestrian-only streets prioritize people and are typically most appropriate in corridors with commercial activity on both edges of the street. They are strategically selected streets in which pedestrian volume is high and vehicular traffic is restricted. These streets offer opportunities for diverse activities such as shopping or sitting, dining or dawdling, promenading or performing. When placed, designed, and maintained well, pedestrian-only streets become a destination and result in economic benefits for adjacent businesses.[1]

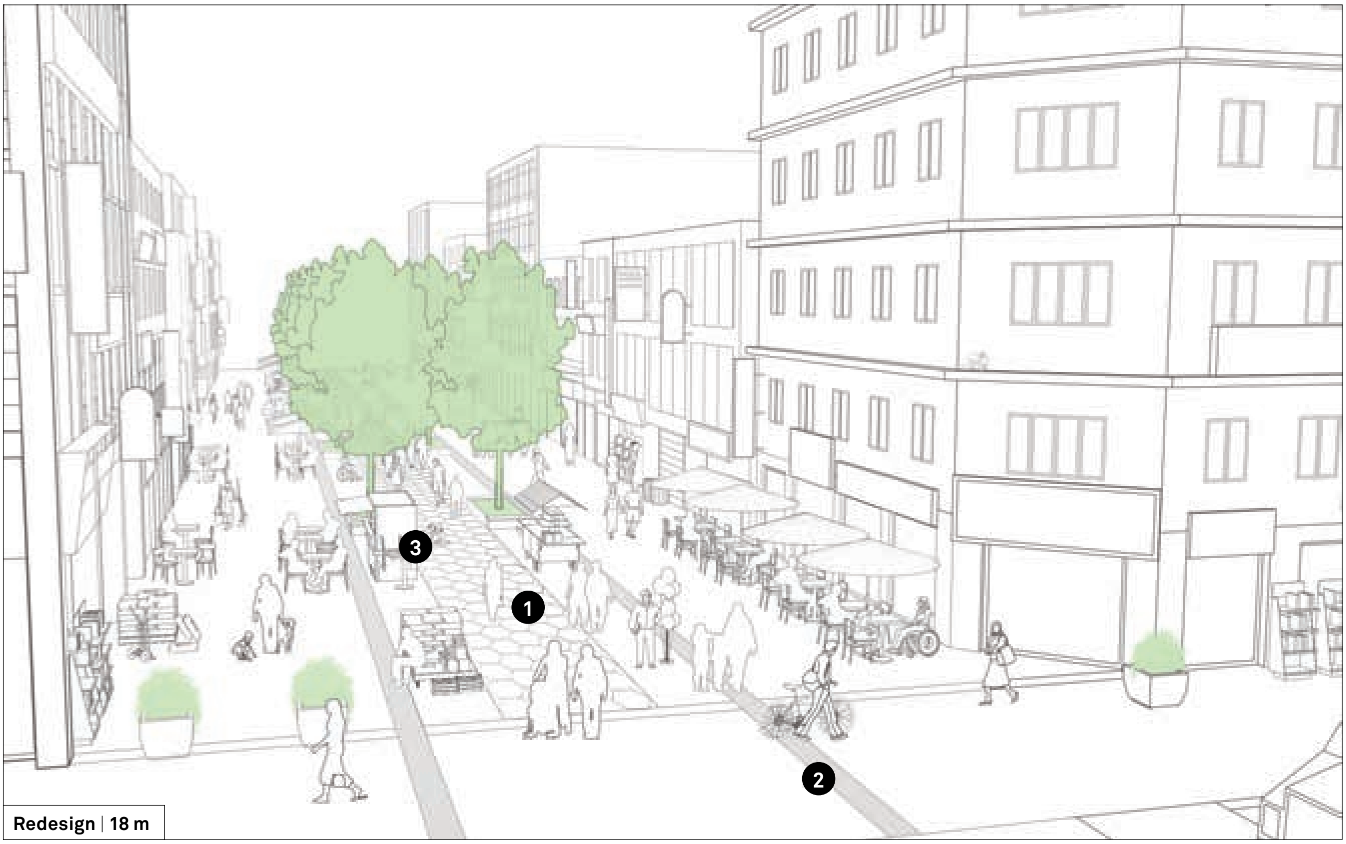
Existing Conditions

Traffic congestion and commercial activities might block the sidewalks and overtake the pedestrian environment.

Destinations on both sides of the street result in frequent mid-block crossing and multiple desire lines.

Pedestrian-only streets might function as a shopping street, with dense commercial and mixed-use activity, serving high pedestrians volumes.

Prishtina, Kosovo. Mother Teresa Boulevard is a pedestrian-only street in the city center that provides a space for promenading, people watching, and playing.



Redesign | 18 m

Design Guidance

Explore pedestrianization when pedestrians overflow onto the roadbed on a regular basis.

Carefully select streets to be pedestrianized based on immediate context. Lack of pedestrians can render these streets unsafe and uninviting. Pedestrian-only streets should be situated in high-density, mixed-use office or commercial areas where pedestrian numbers are high.

Pedestrian-only streets must be well connected to collective transit, cycle routes, and walking paths. Access from side streets or through streets should offer multiple options to move in and out of the corridor, keeping the space permeable. *See 6.3.2: Pedestrian Networks.*

Provide drop-off and pick-up points for vehicles carrying passengers with ambulatory difficulties.

1 Minimum clear paths should be maintained to allow emergency vehicle access. Prohibit parking and vehicular traffic to ensure that clear paths remain unobstructed.

Provide a smooth and level surface to optimize walking accessibility. While clear paths are not required to be straight and direct, they must be continuous and navigable.

2 Use durable and slip-resistant materials. Provide accessibility ramps and tactile paving to assist the visually impaired.

3 Add street furniture, artwork, seating, tables, benches, trees, landscaping, cycle racks, and water fountains to add character and support a range of activities.

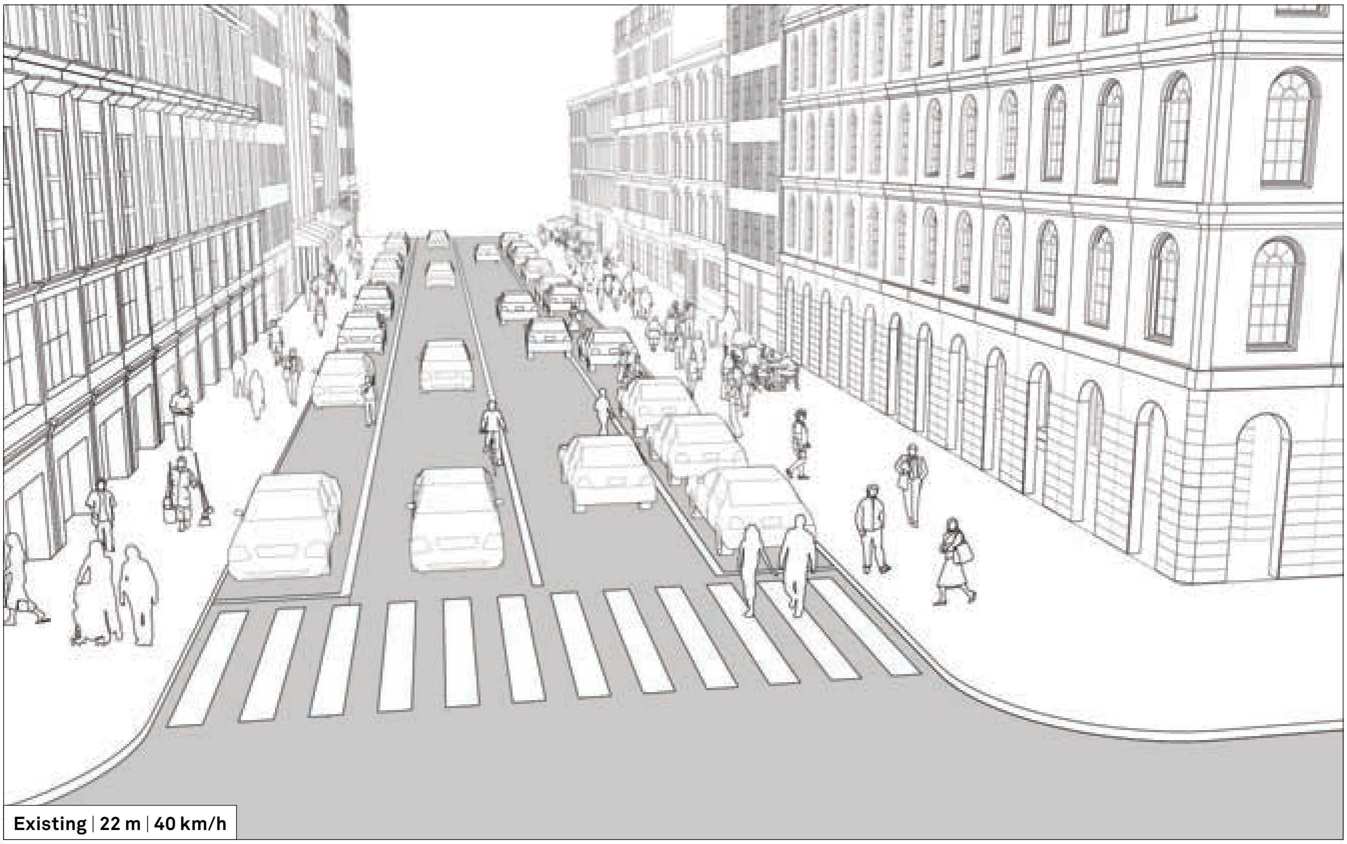
Restrict loading access to certain times of day, preferably off-peak hours, for local businesses and residences.

Lighting must support a safe environment. Facade lighting, pedestrian-scale light poles, and shorter light fixtures can be used to evenly light the space. *See 7.3.1: Lighting Design Guidance.*

Schedule regular maintenance to keep the space clean. Waste receptacles should be provided, and their number based on pedestrian volumes.

Program activities and events, particularly if the corridor is long. Create frontage zones and vendor spaces to organize on-street activity. Ensure breaks are provided between vendor areas to maintain visibility and permeability.

Pedestrian-Only Streets | Example 2: 22 m



Additional Considerations

In some cases, a complete pedestrianization may be appropriate only for a few blocks where pedestrian traffic is the highest.

The types of businesses and land uses that occupy the pedestrian corridor and its side streets will affect the street's function and character at different times of day.

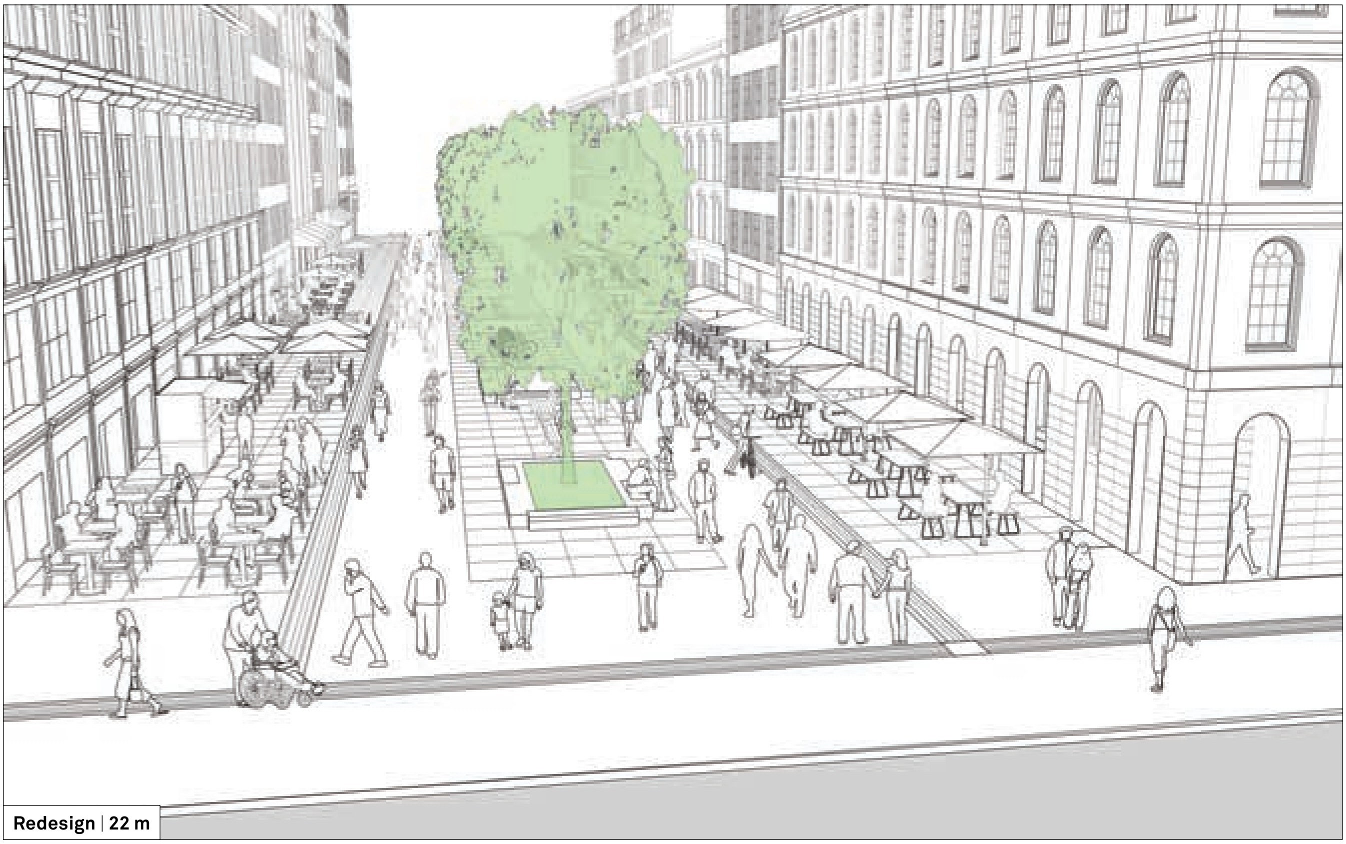
Temporary pedestrianization, using bollards, posts, and diverters, can provide an opportunity to collect comparative data and determine the impacts of closing the street to traffic permanently.[2]

Shared streets or other pedestrian-priority streets can be implemented in streets with lower pedestrian volumes to complement pedestrian-only streets or transit. *See 10.2: Shared Streets.*

Provide signs that encourage cyclists to disembark and walk with their cycles, especially in high pedestrian-volume corridors.

Depending on pedestrian density and street width, it may be appropriate to allow cycles in the street if they travel close to walking speeds.

Istanbul, Turkey. Istiklal Avenue is one of the most famous avenues in the city, stretching 1.4 km and lined with a mix of cultural and commercial uses in historic buildings. Measuring approximately 15 m wide, this avenue was pedestrianized in the late 1980s and still runs an occasional historic tram down the center.



LIUYUN XIAOQU; GUANGZHOU, CHINA

Located in the city's central commercial area, Liuyun Xiaoqu is a dense, mixed-use neighborhood with mid-rise buildings set into small blocks, constraining the amount of street space available. Because the street space is so limited, most of it is dedicated to pedestrians, and motor vehicles are prohibited from entering. Parking provision is very limited and controlled at the perimeter.

Initially, Liuyun Xiaoqu was a gated, single-use residential block, typical of the housing estates built in the late 1980s. Since 2000, when the tenants in the buildings gained the titles to their apartments, the owners started converting their premises to commercial uses, at first for local shops and later for designer clothes and cafés. The ground floor conversions began in 2003, starting near Tianhe Plaza, and eventually expanded until nearly all the ground floors was converted to commercial use, turning the area into an open, mixed-use neighborhood. Leading up to the 2010 Asia Games, which were held in close proximity to the neighborhood, the municipality improved the utilities and infrastructure, invested in the pedestrian areas and landscaping, and added some architectural ornamentation.

The district is well-served by nearby BRT and Metro rail stations, which makes it an accessible destination regionally and connects residents and visitors to the larger transit network.

Liuyun Xiaoqu; Guangzhou, China

CASE STUDY

Strøget; Copenhagen, Denmark

Location: Central Copenhagen, Denmark

Population: 0.5 million
Metro: 1.9 million

Length: 1.15 km (0.7 mi)

Right-of-Way: 10–12 m

Context: Mixed-use (Residential/ Commercial)

Maintenance: Several repavings since 1963

Funding: Public

Overview

Until 1962, all the streets and squares of central Copenhagen were used intensively for vehicle traffic and parking, and were under pressure from the rapidly growing fleet of private vehicles.

The pedestrianization of Copenhagen began with the city's main street, Strøget, which was converted in 1962 as an experiment. The conversion of the 1.15 km-long main street into a pedestrian street was seen as a pioneering effort, which gave rise to much public debate before the street was converted. "Pedestrian streets will never work in Scandinavia" was one theory. "No cars means no customers and no customers means no business," said local business owners.

Soon, Strøget proved to be a huge success, with businesses realizing that traffic-free environments provide increased financial revenue. Magasin Torv, the square by Nikolaj Church, and Gråbrødre Torv were the first squares to be renovated.

Before

After

Photos: Gehl Architects

The pedestrianization of Strøget highlighted the potential for outdoor public life in Denmark.

Key Elements

Removal of all traffic from the street.

Removal of curbs and sidewalks, addition of new paving.

Consolidation of street furniture to facilitate pedestrian movement.

Goals

- Improve connectivity in the city center.
- Provide a high-quality and attractive environment.
- Create a space that supports businesses.
- Encourage a diverse range of people to live and spend time in the city center.
- Revitalize the city's forgotten alleyways by turning them into vibrant laneways.

Involvement

City of Copenhagen, Stadsarkitektens Direktorat, Stadsingeniørens Direktorat, Bjørn Nørgård.

Keys to Success

The successful pedestrianization of streets in Copenhagen can be attributed, in part, to the incremental nature of change, giving people the time to change their patterns of driving and parking into patterns of cycling and using collective transport to access key destinations in the city—in addition to providing time to develop ways of using this newly available public space.

Lessons Learned

The pedestrianization of Strøget highlighted the potential for outdoor public life in Denmark, as Danes never before had the room and the opportunity to develop a public life in public spaces. This pedestrianization created peaceful, yet lively, public spaces. Strøget also proved that pedestrian streets can increase revenue for local retailers.

Evaluation

+35%

Increase in pedestrian volumes in the first year after the conversion.

+600%

Increase in pedestrian space, from 15,800 m² in 1962 to 99,700 m² in 2005.

+81%

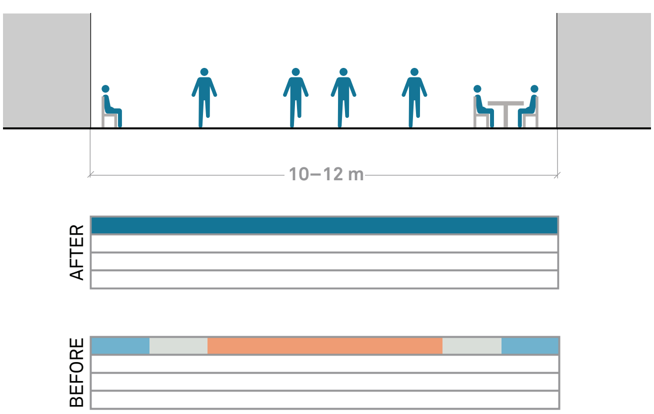
Increase in outdoor café seating, from 2,970 seats in 1986 to 7,020 in 2006.

+400%

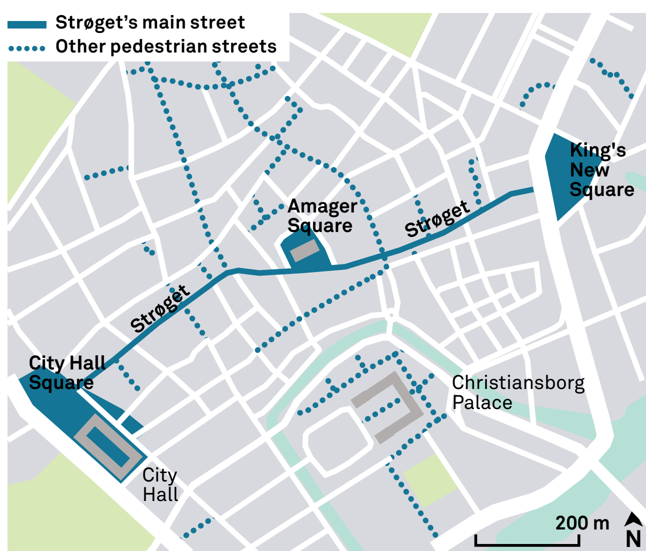
Increase in stopping and staying activities from 1968 to 1996.

+20%

Increase in citywide pedestrian volumes to 15 min/day on average.



User legend:
Pedestrian space
Mixed traffic
Parking



Project Timeline

1962–Today

Strøget has been renewed and upgraded several times during its 53 years as a pedestrian street, by using progressively better-quality materials, repurposing public spaces and plazas to increase pedestrian comfort, and adding outdoor uses.

Amager Square was renovated in 1993 by local artist Bjørn Nørgård. Today, it is the second most popular urban space in the city because of the diverse range of activities offered there.

10.3.2 | Laneways and Alleys | Example 1: 8m

Laneways, also known as alleys, are narrow streets that add to the diversity of the overall public space network, supporting the fine grain character of a city. Often retrofitted from old service lanes, commercial laneways provide opportunities to create new front doors to forgotten spaces, prioritize pedestrians, and add vibrant spaces to a neighborhood. Laneways can work as a network for pedestrians to navigate the city and build an overall identity for the city center.[3]

Cities around the world have been transforming their laneways from back alleys filled with trucks and delivery vans to new front-facing active edges, creating inviting spaces for locals and visitors.

Existing Conditions

Laneways are generally lined by continuous buildings on both sides, creating a strong sense of enclosure.

Commercial laneways are typically activated by small-scale retail, workshops, galleries, cafés, or restaurants. Rents for these spaces are initially low, inviting new businesses to move in and attracting customers to the space.

They are often in close proximity to larger central streets or public spaces, and offer convenient access to key destinations.

They provide beneficial shortcuts for pedestrians traversing large city blocks, increasing the overall permeability of the city.

Residential laneways may be faced by garages and limited residential access. Alleys and laneways may be important for local utilities and waste collection, but may be poorly lit and trafficked, creating an unsafe atmosphere for pedestrians.

Design Guidance

1 Increase the frontage area available for businesses in the city and create intimate environments by transforming laneways and alleys with active ground floor uses.

Each lane must be assessed and designed on a case-by-case basis to ensure that loading and other services can be accommodated when needed.

If vehicles are given access, limit travel speed to 10 km/h.

2 Maintain an accessible clear path of 3.5 m for emergency vehicle access. Permanent furniture may be placed along building edges, or located at the center of the lane, while maintaining a clear path along the buildings. Movable furniture can be placed in the emergency access path so long as they do not impede necessary but infrequent movements. Plan for local emergency access, and provide adjacent through routes. *See 6.7: Designing for Freight and Service Operators.*

Provide cycle parking and cycle-share facilities in the immediate surroundings of the laneway.

Prohibit parking in laneways except under special circumstances.

Restrict access for loading and deliveries to early morning and late evening when pedestrian activity is lower.

Use lighting to shape the character and experience of the space while providing a safe environment at all hours.

Schedule regular maintenance and management to ensure that the laneway remains clean and free of obstacles.

Design pavement slope to assure efficient drainage of primary pedestrian areas.[4]

Where a laneway meets a higher-traffic street, provide raised pedestrian crossings to suit the context, street size, and travel speeds.[5] *See 6.3.5: Pedestrian Crossings.*

Laneways and Alleys | Example 2: 10 m

Existing | 10 m | 20 km/h

Additional Considerations

Local climates will affect the street experience and use. Consider covering laneways to provide protection from the weather and encourage year-round use. Screens may be used to protect from wind.

Engage local artists, residents, and businesses to shape the character of the space according to uses and business types.[6]

Use of signage, building textures, and material variety on building edges add visual interest to the laneway.

Commercial laneways should have active ground-floor activities. Encourage businesses to provide large and transparent openings directly onto the lane to increase activity.

Tokyo, Japan. A back alley hosts commercial uses and maintains emergency egress.

Redesign | **10 m** | **10 km/h**

Sydney, Australia. Newly converted Ash Street, connecting Angel Place and Palings Lane, is lined with restaurants and cafés.

Cairo, Egypt. A local laneway attracts evening activities, keeping the street safe and lively.

CASE STUDY

Laneways of Melbourne, Australia

Location: Melbourne City Center; Melbourne, Australia

Population: 4.4 million

Extent: Extensive network of alleys and laneways

Right-of-Way: Approximately 5–10 m

Context: Mixed-use (Residential/ Commercial)

Cost: Varies depending on laneway

Funding: City of Melbourne in partnership with local businesses

Speed: 0–5 km/h (Many laneways do not allow vehicle access. Some allow limited access.)

The network of laneways improves connectivity and legibility within the Central Business District (CBD), while providing attractive environments that support local businesses.

Centre Place Lane

Block Place

Hardware Lane

CASE STUDY

Overview

The revitalization of Melbourne's laneways began in the early 1990s when the City of Melbourne and state government worked to protect and upgrade the remaining laneways. This was part of a larger regeneration program intended to bring people back to the city after work hours, and make the city an exciting, safe, and hospitable environment.

The streets were cleaned up, and active street frontages and mixed-use development were encouraged. The city worked with universities to encourage the large international student population to live in the city and bring along cultural diversity and energy to public areas.

An ongoing, temporary public art program was developed, bringing a sense of excitement and discovery to the laneways. Small local retailers, particularly cafés, were encouraged to move into the CBD and take up laneway spaces facing the street. Nighttime activity was encouraged with incentives for retailers to stay open for longer hours.

Key Elements

Pedestrian-priority spaces with no vehicular traffic.

Quality paving materials and custom designed lighting.

Removal of obstacles, bollards, curbs, and redundant street elements.

Improved cleaning, supervision of laneways, and wayfinding.

Activation including cultural and arts events.

Goals

- Revitalize interest and activity in the city's laneways.
- Improve connectivity and legibility throughout the city center.
- Provide a high-quality and attractive environment that supports businesses.
- Encourage a diverse range of people to live and spend time in the city center.

Lessons Learned

Partnerships with building owners are key to the success of laneways.

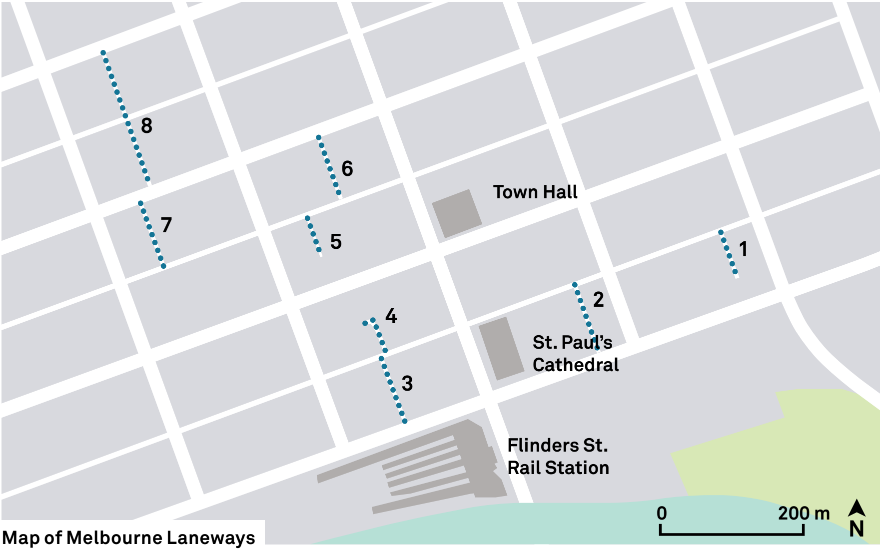
Partnership between the municipality and small retailers has generated investment in laneway projects.

Curbside dining proved successful even during colder seasons.

Melbourne's laneways have become a highly popular tourist attraction.

Involvement

City of Melbourne, local business associations, artist collectives, and resident associations.



Map of Melbourne Laneways

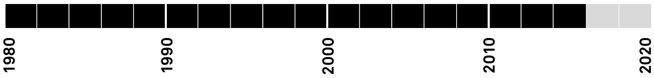
Melbourne laneways site map

A few of the best-known laneways in downtown Melbourne create a series of shortcuts for pedestrians to navigate the city center.

1. Malthouse Lane
2. Hosier Lane
3. Degraves Street
4. Centre Place Lane
5. Block Place
6. Union Lane
7. McKillop Street
8. Hardware Lane

Project Timeline

1980–Today



During the 19th and 20th centuries the laneways were privatized, closed off, built in, and neglected.

However, in the 1990s, the true potential of the laneways was identified. Since then, efforts have been made to upgrade and further develop the laneways.

10.3.3 | Parklets | Example

Existing

Parklets are temporary or permanent conversions of on-street, curbside parking spaces into vibrant and accessible new public spaces. Also known as street seats, pocket parks, mobile parks, or curbside seating, these are often the product of a partnership between the city and local businesses, residents, or neighborhood associations. Parklets are often applied alongside sidewalks that are too narrow or congested to allow for the extension of sidewalk cafés or street furniture.

Existing Conditions

Parklets generally entail the conversion of two or more parallel parking spaces, or three to four angled parking spaces. The configuration will vary according to the site, context, and desired character of the installation.

Parklets may be installed on streets that have high pedestrian volume and local business activity, but lack public space for pedestrians.

Where on-street parking is often obstructed due to spillover of street activity, the city can allow the change in use of one or more parking spaces through a permitting process, requiring that the spaces remain open and accessible to the public.

Redesign

Design Guidance

1 Parklets must be buffered using a wheel stop at a desired distance of **1.2 m** from the parklet to ensure visibility to moving traffic, pedestrians, and parked vehicles. This buffer may also serve as a space for adjacent property owners to accommodate curbside trash collection.

2 Incorporate vertical elements such as flexible posts or bollards to make parklets visible to traffic.

Allow a minimum width of **1.8 m** for the parklet, or the width of the parking lane.

Provide small channels between the base and the platform to facilitate alternate drainage, so that the design of a parklet does not inhibit stormwater runoff.

3 Ensure that parklets have a flush transition at the sidewalk and curb to permit easy access and avoid trip hazards.

Place parklets at least **5 m** away from the intersection. Where the installation of a parklet is under consideration for a site near an intersection, analyze volumes of turning traffic, pedestrian flows, sight lines, and visibility.

Furnish parklets in ways that make theft impossible or unlikely. Site selection should consider the level of surveillance both during the day and at night.

Use movable tables and chairs and integrate seating and other features into the parklet structure to enhance flexibility and usability. Work with partners to manage moveable furniture and potentially store them elsewhere overnight.

Designs for the substructure of a parklet vary and depend on the slope of the street and overall design of the structure. The substructure must accommodate the crown of the road and provide a level surface for the parklet.[7]

Deck-pedestals spaced under the surface at different heights are commonly applied to achieve flush level surface. Another method is to provide steel substructure and angled beams.

Use slip-resistant surfaces to minimize hazards and ensure wheelchair accessibility.

Load-bearing capacity of floors vary by local agency. At a minimum, design for **450 kg/m**.[8]

Include an open guardrail to define the space. Railings should be no higher than **0.9 m** and capable of withstanding at least **90 kg** of horizontal force.

Additional Considerations

The design of a parklet varies according to the wishes of partners or applicants. Designs may include seating, greenery, cycle racks, or other features, but should always strive to become a focal point for the community and a welcome gathering place.

Guidance should be developed at the city or regional level to encourage creative design that enhances the local context while maintaining appropriate safety standards.

In some cases, parklets may be operated by street vendors and can act as temporary pop-up shops.

Parklets are easier to administer through partnerships with adjacent businesses or surrounding residents. Involve local partners to program, fund, and maintain the parklet, and to keep it safe and clean.

Where no local partners are present, a parklet may be installed and managed by the city as a traditional park or public space.

Parklets are easy to implement and test as they can be created with low-cost materials and community participation.

They can provide an opportunity to collect comparative data to estimate the longer-term impact of replacing parking with public space.

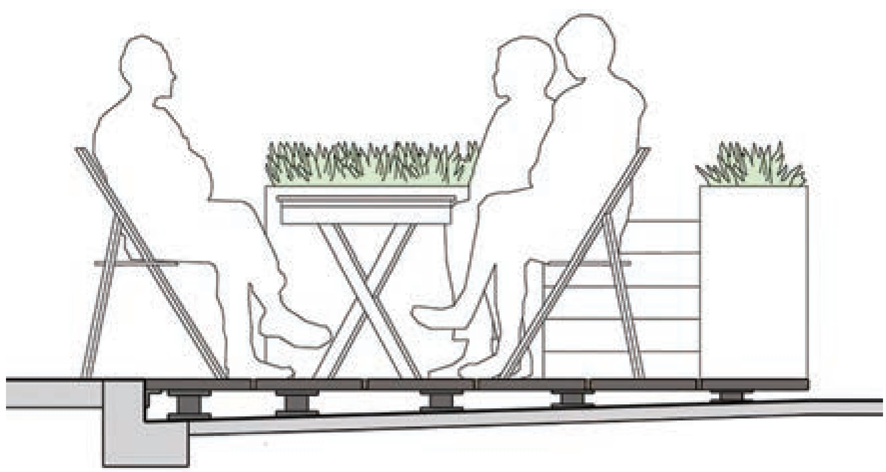
Parklets are best tracked and measured when administered as part of a citywide program by the city transportation, planning, or public works agencies.

Cities may opt to use a prototype or standardized designs to increase affordability.

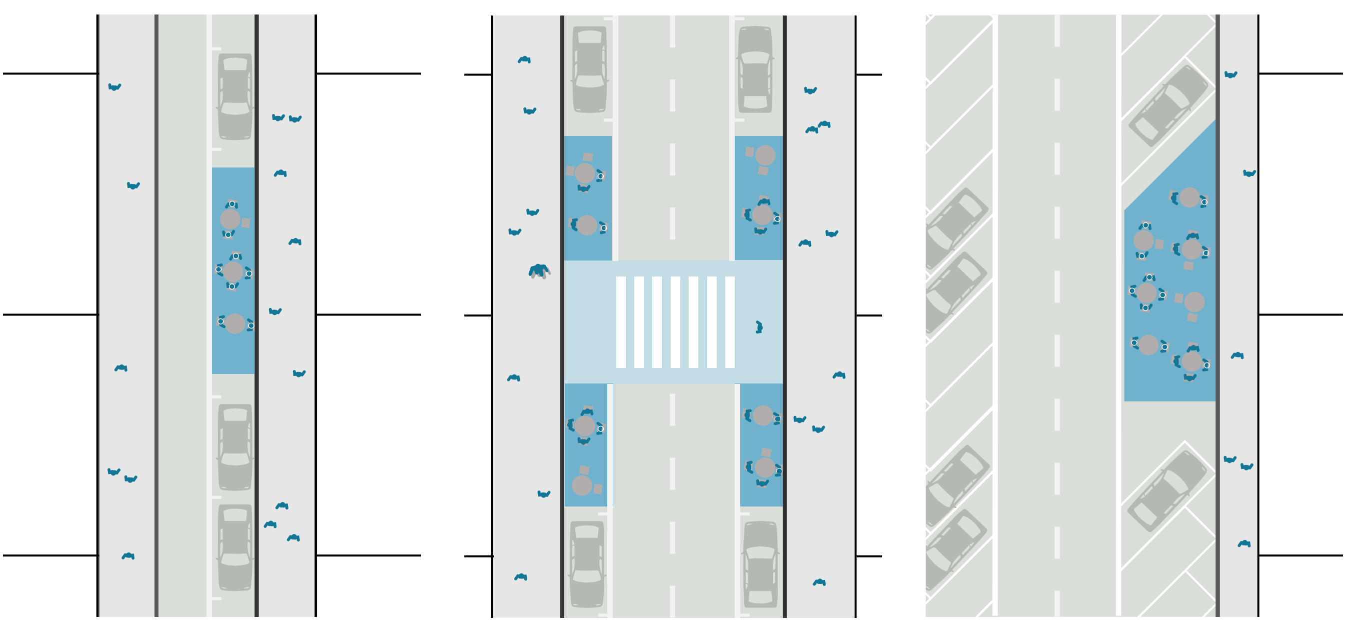
Cycle racks or physical activity equipment may be incorporated into or adjacent to the parklet.

Cities with heavy snowfall or extreme rain or floods should consider seasonal use and take local maintenance protocols into account.

While parklets are primarily intended as assets for local communities, they have been shown to increase pedestrian volumes, and generate revenue for adjacent businesses.[9]



This typical parklet section shows how the slope of the roadbed can be accommodated to provide a flush transition between the sidewalk and the parklet surface.



Parklets vary in configuration and design but typically replace two or more parallel parking spaces, or three to four angled parking spaces. They can include seating, tables, planting, cycle racks, artwork, shade structures, and other elements.

SÃO PAULO, BRAZIL

Following the success of the first parklet project at Rua Padre João Manuel in 2014, parklets became part of the citywide master plan of São Paulo to encourage additional public spaces as part of street design. A specific policy (DECRETO Nº 55.045) now regulates the creation and maintenance of parklets throughout the city. These parklets consist of fixed seating, planters, and cycle parking, and local design guidance assists to streamline the process.

As of May 2016, a total of 42 parklets have been built by private initiatives in São Paulo, and the municipality agreed to an additional 32 public parklets, one for each district, to expand the program to other parts of the city.

São Paulo, Brazil. A top view of a parklet on Rua Padre João Manuel which set a precedent for new policies regulating parklets in the city.

GLASGOW, SCOTLAND

This pilot parklet was created in exchange for a loading bay and is part of a wider Regeneration Framework enacted by the Glasgow City Council. It was designed in collaboration with the parklet host and features wooden benches, greenery, a seasonal canopy, and local information boards. Built by Community Safety Glasgow, with assistance from volunteers in their Community Pay Back Program, the parklet was constructed using reclaimed timber.

Glasgow, Scotland. This parklet was constructed as part of Sauchiehall Regeneration Framework, under the City Center Regeneration pilot.

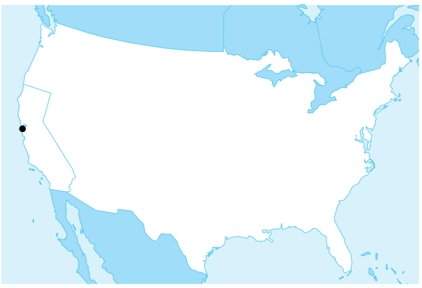
LIMA, PERU

The first parklet in Lima was conceived in February 2015, as a result of a Pocket Urban Intervention workshop. Since the municipal authorities were skeptical about the duration of use and quality of space, it was constructed with funding and efforts of students and teachers of a local institution. Well received by the media and the local community, the project was made part of a new program called "New Green Spaces," initiated by the Environmental Office, Municipality of San Borja. There are plans to continue the construction of parklets in other parts of the city.

Lima, Peru. A parklet in San Borja conceived as part of a workshop held by an organization called Ocupa Tu Calle, and promoted by Lima Cómo Vamos and Fundación Avina.

Pavement to Parks; San Francisco, USA

CASE STUDY



Location: San Francisco, California, USA

Population: 0.8 million
Metro: 4.5 million

Extent: 65 parklets installed citywide; 7 street plazas installed citywide

Size: 2–2.5 m x 10–12 m

Context: Mixed-use (Residential/ Commercial)

Cost: Commercial and residential
- Construction 10,000–30,000 USD
- Fees 2,000 USD
- Annual permit 250 USD

Funding: Private
(Cost of construction and fees are covered by the applicant.)

Overview

San Francisco has been credited with the creation of the first parklet. Parklets were introduced with street plazas in 2009 as part of a collaborative effort between several municipal agencies, now called the Pavement to Parks (P2P) program.

Because of the involvement of local nonprofits and business owners, parklets are context-oriented street improvements.

The creation of parklets and similar small-scale open spaces has inspired a widespread effort across a number of cities in the United States and around the world. As of March 2015, more than 60 parklets have been installed by merchants, neighborhood groups, nonprofits, and other organizations throughout San Francisco.

Before

After

Photos: Sam Heller

Parklets offer a simple and cost-effective way to enhance the public realm, especially in areas where sidewalks are inadequate, too small, or too crowded.

Key Elements

Parklets are removable and do not impede curbside drainage.

Parklets are open to public; stewards may not use them exclusively nor for commercial purposes.

Parklets are universally accessible. They are all raised to curb height with no obstacles to wheelchair access.

Goals

- Reimagine a street's potential.
- Foster neighborhood interaction.
- Enhance pedestrian safety and activity.
- Encourage non-motorized transportation.
- Support local businesses.

Involvement

San Francisco Planning Department, San Francisco Public Works, Municipal Transportation Agency (SFMTA), Local Business Association, citizen associations, nonprofit organizations, and Community Benefit Districts.

Keys to Success

A strong steward or local partner, who oversees daily operations and maintenance, is crucial to long-term success.

Cities should cultivate a diverse set of project partners. These may be neighborhood organizations, service, or cultural institutions, or other nonprofits, in addition to merchants and commercial entities.

Activity throughout the day and week ensures a public space is well loved and used. Activity also encourages more social mixing with a greater sense of safety and comfort. Ideal sites are surrounded by uses that naturally generate pedestrian activity.

Regular programs with local cultural and institutional partners help build a positive place identity, local stewardship, and pride.

Evaluation

+4%

Increase in pedestrian activity

+11%

Increase in cycle volume

160

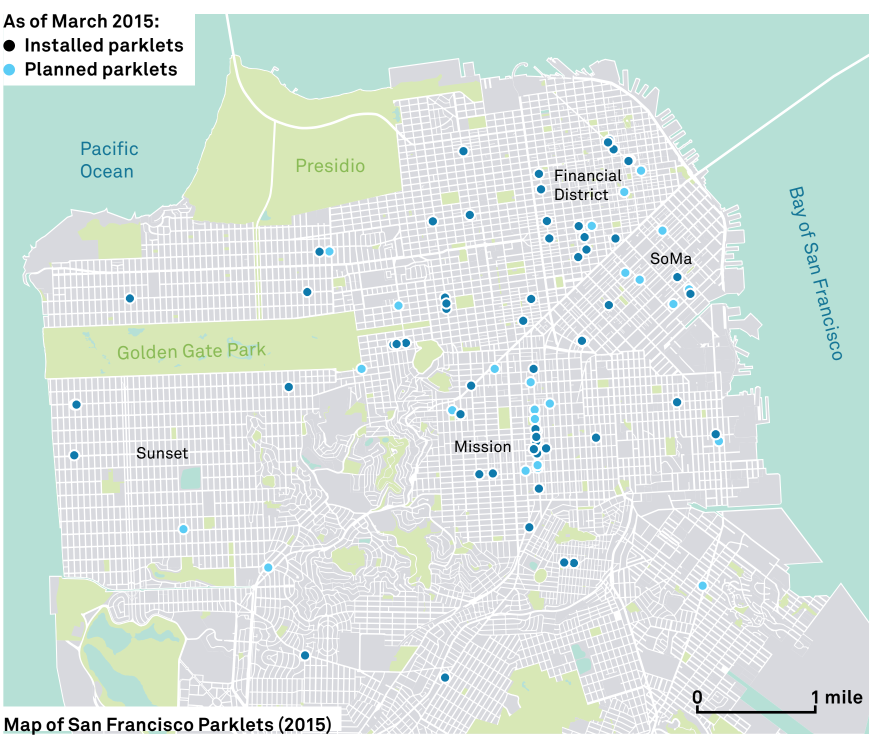
Converted parking spaces (2009–2015)

5,600

Square meters of roadway converted to parklets and street plazas

61%

Pedestrians feeling "very safe" from vehicles when in parklets



Map of San Francisco Parklets (2015)

Lessons Learned

Start Small. Pop-up demonstrations and short-term pilots help open dialogue about larger and longer-term installations.

Follow-Up Is Key. After various pilot phases of a project, communicate lessons learned and next steps with city and public stakeholders. Document stakeholder roles, expectations, and design and operating parameters, as they evolve through different phases of a project and program.

Emphasize Equity. As the program grows, ensure that disadvantaged neighborhoods and communities are being served.

10.3.4 | Pedestrian Plazas | Example

Existing

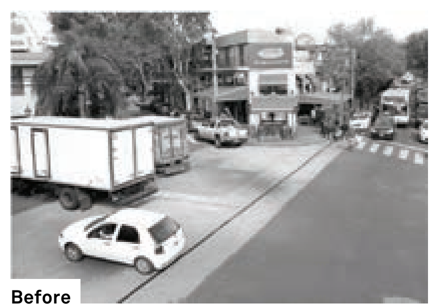
Public plazas transform underutilized areas of the street into vibrant social spaces for surrounding residents and businesses. They are a result of successful partnerships between the city and a neighborhood group or business association. The city offers the land, while the partners maintain, oversee, and program the space. Plazas energize surrounding streets and public spaces, creating foot traffic that can boost business and invigorate street life.[10]

Existing Conditions

Large or complex intersections often have confusing traffic patterns, especially for pedestrians, which results in chaotic and uninviting walking.

Irregular crosswalks create long pedestrian crossing distances, which increase exposure time for vulnerable users and encourage informal crossings along desire lines.

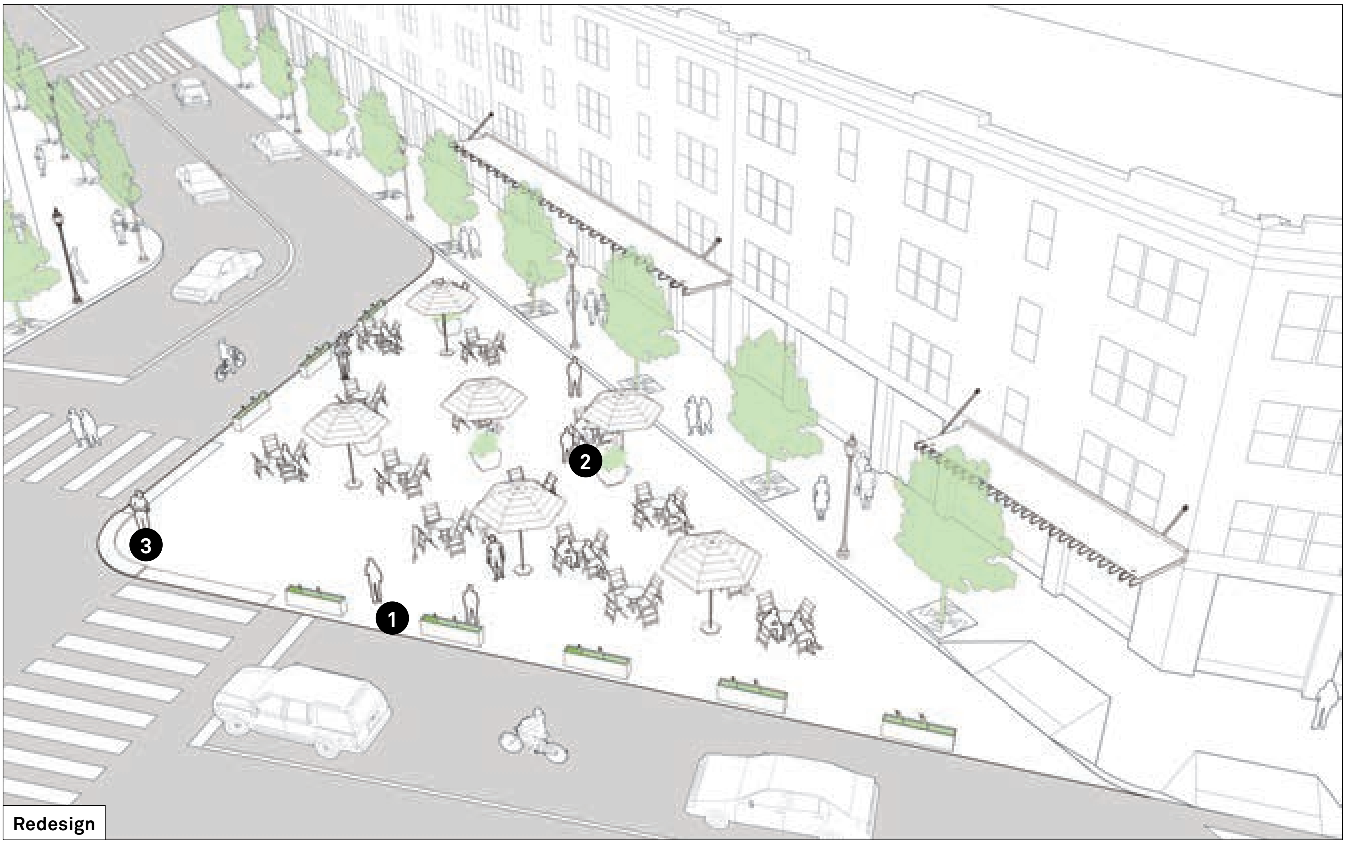
Complex geometry creates large tracts of underutilized pavement, further degrading conditions of safety and comfort.



Before

After

Intersection in Buenos Aires, Argentina



Redesign

Design Guidance

Rethinking the dimensions of the street to better balance the needs of all users reveals excess spaces. These spaces can be re-attributed to pedestrian use, contributing to a neighborhood's open space needs.

Use public plazas to reconfigure and revitalize intersections that might otherwise be unsafe or underutilized. Plaza reconfigurations make intersections safer by slowing traffic speeds, simplifying complex traffic patterns, and helping to mitigate potentially dangerous conflicts. *See 11.11: Complex Intersection: Adding Pubic Plazas.*

Plazas transform and activate underutilized street segments and provide relief where pedestrian demand is unmet and foot traffic overflows into the roadway. They make the roadway and intersections more compact, and easier for pedestrians to cross.

Prohibit parking within the public plaza. Initial enforcement may be required to prevent unauthorized parking.

❶ Define the edges of the plaza with official markings that prohibit vehicles from entering the space. This can be done by painting or by adding bollards or planters.

Give proper attention to navigation by individuals with low vision or mobility impairments; provide accessible ramps and surfaces, and tactile warning strips with high color contrast between modal zones. *See 6.3.8: Universal Accessibility.*

Take local climate and durability into consideration in the selection of materials and the maintenance plan of the plaza.[11]

Provide adequate lighting to ensure safety at all hours.

❷ Provide a mix of permanent and temporary seating to permit flexible use of the space and limit costs. Maintenance partners should determine whether furniture should be secured at night.[12]

❸ Corners and other areas of a plaza that are subject to encroachment or turning vehicles should be reinforced using heavy objects such as planters and bollards that alert drivers to the new curb line.

Install cycle parking or cycle-share stations where space permits.

Accommodate early morning or late night freight loading and unloading in temporary and permanent designs.

Integrate drainage channels and permeable surfaces into the design of the plaza. Sites should have minimal cross slope and use edge treatments that mitigate the overall slope.

Additional Considerations

Informational signage and community outreach are recommended prior to implementation to ensure that local stakeholders are aware and engaged in the project.

Art installations, performances, vendors, and markets improve the quality of and create an identity for public plazas while engaging local artists, communities, and business owners in the process.

Plazas may be introduced as an interim intervention, with low-cost materials such as paint, epoxied gravel, movable planters, and flexible seating. This intermediate application allows the community to build support for a public space in the near term, and test design solutions before major capital construction.

Temporary plazas are appropriate when:

- Safety or operational issues with existing traffic call for a temporary reconfiguration of an intersection.
- Funds have been allocated for the permanent installation of a plaza, but capital implementation remains several years away.

City-Led Plaza Programs

A city agency should identify opportunities to reclaim portions of the roadway and incorporate them into the public realm as a part of regular planning, design, and construction work. They can then maintain the plaza under the city budget or partner with local community organizations to manage ongoing maintenance.

Community-Led Plaza Programs

Cities should begin a formal public plaza program where local partners such as community groups, nonprofit organizations, associations, or business improvement districts propose a new plaza site through an application process.

Formal partnerships ensure that community partners assume responsibility for the space by committing to operate, maintain, manage, and program the plaza so it remains vibrant, safe, and active.

Cities may prioritize neighborhoods where there is a lack of open space and fund the design and construction of the plaza through a community engagement process.

MEXICO CITY, MEXICO

Avenida 20 de Noviembre, in the heart of Mexico City, was transformed with interim materials in 2014 by replacing two underused motor vehicle lanes with 730 m of public space. This plaza increased the public space through widening of the sidewalk.

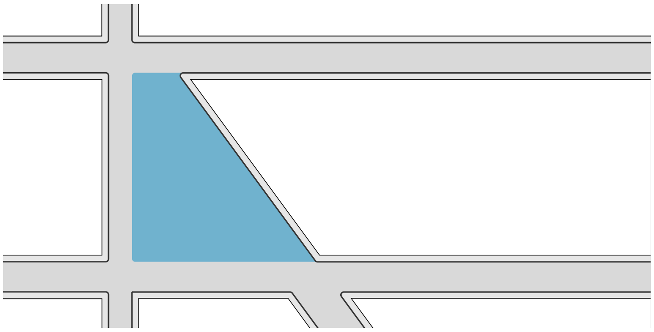
MOSCOW, RUSSIA

Chernigovsky Lane is a narrow street located in the historic district of Moscow, surrounded by churches and historic buildings. Neighborhood residents worked with the local government to convert the street into a pedestrian plaza. The plaza has since become a popular destination for residents and tourists looking to relax after a busy day in downtown Moscow

Plazas Configurations

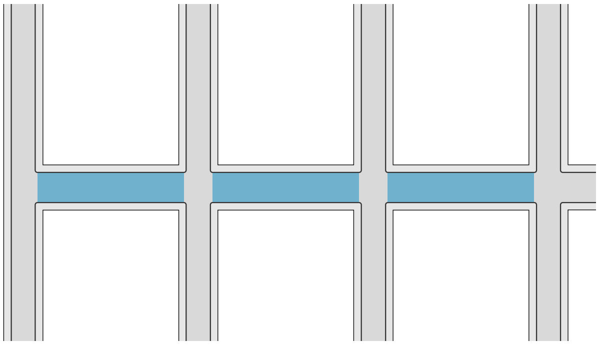
Configuration 1: Reclaimed Plazas

Reclaimed plazas are created by taking over residual street space, empty parking lots, areas under elevated structures, and other spaces that are not appropriately programmed for their context. They are designed for areas with high pedestrian volumes and a lack of public space. They connect public spaces to adjacent land uses and reduce conflicts.



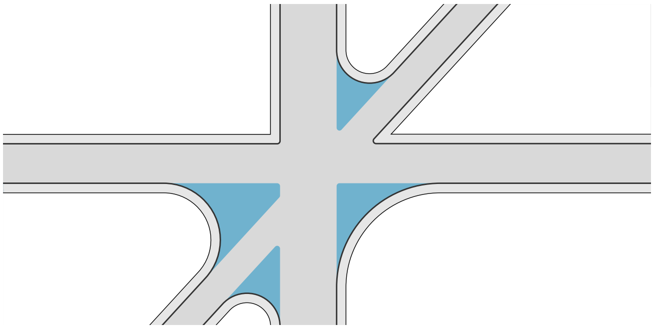
Configuration 2: Through-Block Plazas

Through-block public plazas are developed either by closing off streets for one or more blocks or by allocating public space through super-blocks. These are located in areas of heavy pedestrian volumes such as urban centers, around waterfronts, key attractions, and shopping areas. A constant clear path must allow for universal accessibility and emergency vehicle access. These paths may be lined with trees, planters, lighting, benches, and other furniture.



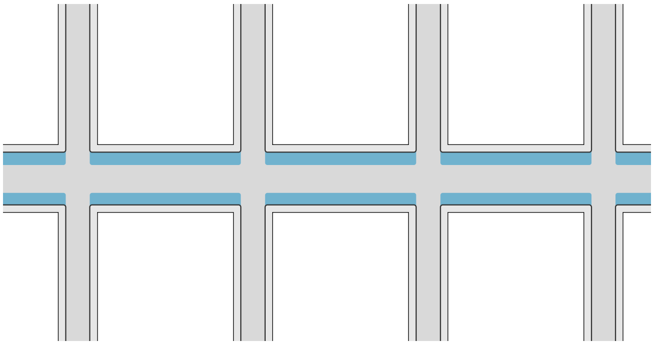
Configuration 3: Intersection Plazas

These plazas provide additional pedestrian space by redesigning intersections to be more compact. Using residual space between intersecting streets, on street corners and traffic islands, these spaces provide a safer and more active pedestrian environment. They are characterized by smaller sizes and angular shapes. These plazas may contain bollards for protection from vehicles, street signage, and cycle-share facilities. This configuration reduces pedestrian crossing distances and slows traffic.



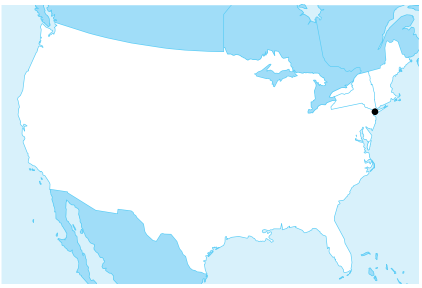
Configuration 4: Sidewalk-Extension Plazas

These plazas create a larger pedestrian realm through widening the sidewalks along the length of a block. It is important to maintain linear clear paths in such cases to allow for unobstructed pedestrian movement. Landscaping and other fixed or movable elements can be used to demarcate public space and walking paths.



Plaza Program; New York City, USA

CASE STUDY



Location: New York City, USA

Population: 8.4 million
Metro: 20 million

Extent: Citywide

Right-of-Way: Varies

Context: Mixed-use (Residential/ Commercial)

Funding: Public and private

Key Elements

Visually enhanced pedestrian space, maximizing comfort and active uses.

Furniture, generally movable seating and tables for maximum flexibility.

Extended areas for open-air activities.

Goals

- Create a pedestrian destination.
- Improve walkability.
- Improve access to transit.
- Enhance vehicular and pedestrian safety.
- Support local development and build community partnerships.
- Preserve and promote neighborhood character

Before

After

Photo: NYC Department of Transportation (DOT)

Overview

The Plaza Program is a citywide effort led by the Department of Transportation (DOT) of New York City to create cost-effective, high-quality public spaces in underutilized roadways throughout the city.

The program aims to prioritize areas that currently lack open space, especially in high-pedestrian or low-income neighborhoods.

Plazas have been proven to enhance local economic vitality, pedestrian mobility, access to public transit, and safety.

NYC DOT partners with nonprofit applicants to develop plazas that meet the needs of local communities. It works with local groups to manage ongoing maintenance.

There are 71 plazas citywide in some phase of planning, design, construction, or completion, with 49 open to the public as of 2015.

Lessons Learned

The Plaza Program is a cost-effective measure to provides amenities that support social gathering, increase a sense of place, and enhance pedestrian movement and safety.

The program builds support for changes through temporary surface treatments, utilizing interim changes to collect data to support permanent change.

Facilitating new public space through an application process allows communities to ask for plazas in their neighborhoods.

Involvement

NYC Department of Transportation (DOT), Department of City Planning, Department of Design and Construction, private partnerships, citizen associations, advocacy groups, and Business Improvement Districts.

Before

Pearl Street, New York. Underutilized spaces used for parking.

After

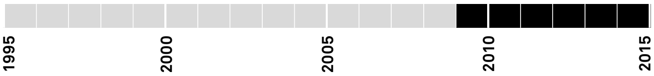
Pearl Street, New York. Plaza activated with seating and planting.

Green Light for Midtown

Green Light for Midtown is a major initiative to improve mobility and safety on the Broadway corridor, in Midtown Manhattan. The project created new pedestrian plazas in the Times Square and Herald Square areas, along with safety improvements along the Broadway corridor between Columbus Circle and Madison Square. The Department of Transportation collected extensive data in the months just prior to and just following project implementation, highlighting the impacts of these measures.

Project Timeline of Green Light for Midtown

2009–2015 (Approximately 6 Years)



Evaluation of Green Light for Midtown

+11% Increase in pedestrian volumes at Times Square

74% Users that declared that Times Square had "improved dramatically"

-40% Decrease in particulate matter in the area

-35% Decrease in pedestrian injuries in the project area

-63% Reduction of injuries to motorists and passengers in the project area

+1.5% Increase in bus ridership on 6th Avenue

10.4
Shared Streets

Many narrow, crowded streets around the world already operate informally as shared streets at busy times of the day or in congested areas. By removing the formal distinctions between spaces dedicated to pedestrians, cyclists, and motorized vehicles, the street is shared by everyone, with each user becoming increasingly aware and respectful of the others.

Formal shared street environments should be considered in places where pedestrian activity is high and vehicle volumes are low or discouraged. In cases where the cross section of a street is too narrow to allow for universally accessible sidewalks with moving vehicles in separate lanes, the street can be redesigned to allow for safe movement and a larger variety of activities.

Shared streets provide pedestrians the right-of-way. While designs vary based on local context and culture, curbs are removed and the materials and space allocation indicate that vehicles are guests.

In commercial areas, shared streets can significantly contribute to the public space network, adding vibrancy and activity with outdoor dining, public seating, artwork, and landscaping. In residential areas, shared streets become the extension of front yards, places to meet neighbors, and build communities. Shared treatments make streets safer for all users.

Bogota, Colombia


20

10.4.1 | Commercial Shared Streets | Example 1: 12 m

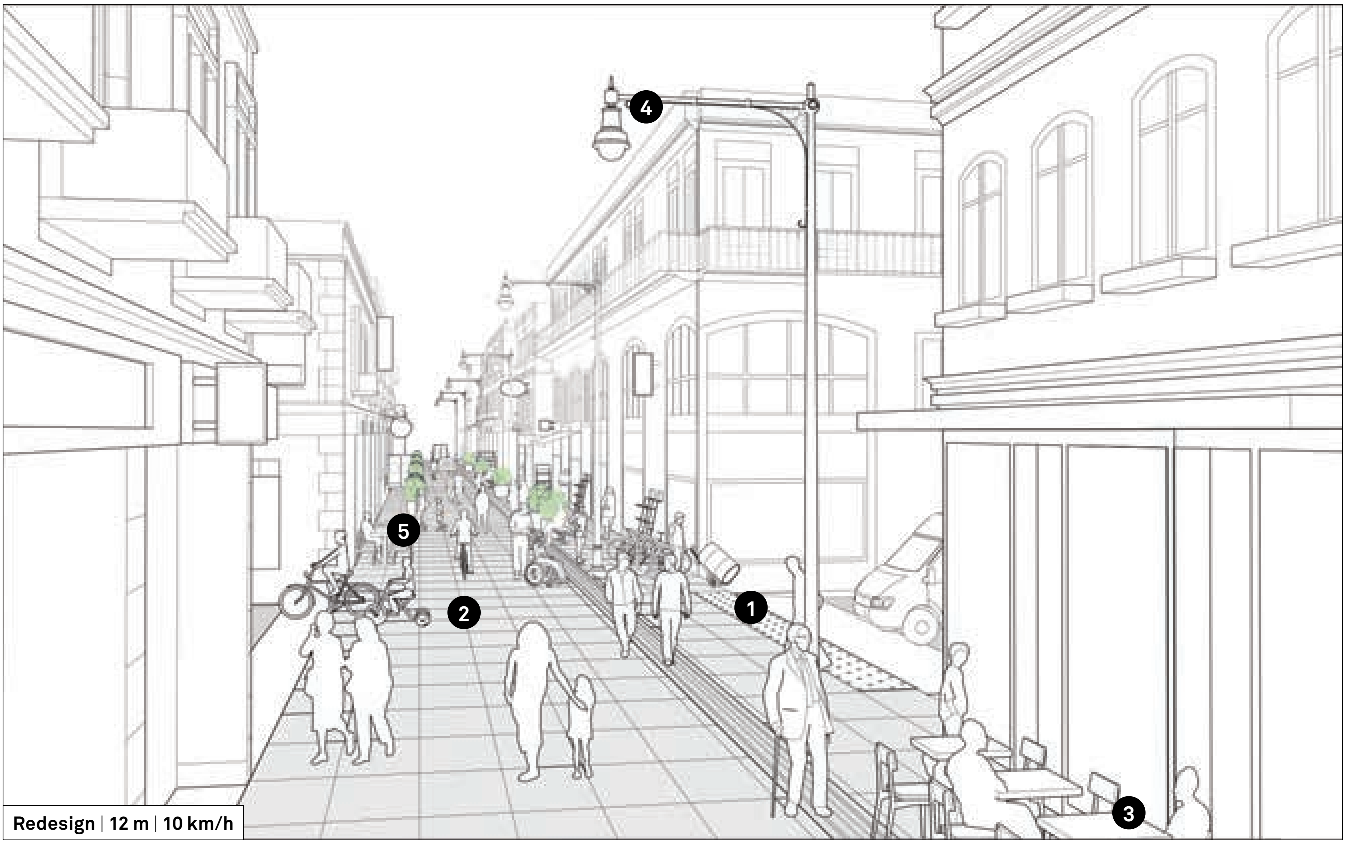
Existing | 12 m | 40 km/h

Shared commercial streets are designed to permit easy loading and unloading of vehicles at designated hours. They are designed to slow traffic speeds using pedestrian volume, design, and other cues.

Existing Conditions

Shared streets are often the default condition in historic cities with narrow rights-of-way. One or two narrow travel lanes may be shared between cars, motorcycles, cycles, and loading vehicles. Due to the limited space, these streets may have narrow and inaccessible sidewalks, with utility boxes and light poles obstructing the pedestrian space. In some contexts, sidewalks are occupied by street vendors and informal parking, forcing pedestrians onto the roadbed.

Bandung, Indonesia. A narrow street hosts commercial activity and acts as a defacto shared street.



Design Guidance

Design strategies must prioritize vulnerable users, ensuring that clear paths are maintained. Work with local accessibility groups to ensure design, materials, and facilities meet local guidelines or standards.

Consider local climate and material availability when developing design. Drainage channels and permeable materials should be provided in accordance with existing curb lines and slope.

Textures and paving must align with the curb to reinforce the pedestrian-priority of the street.

1. Provide tactile warning strips at the entrance to all shared spaces. Warning strips should span the entire intersection crossing. *See 6.3.8: Universal Accessibility.*

2. Maintain a clear path for delivery vehicles, and mark dedicated areas for vehicular movement with a change in paving pattern or type.

3. Use street furniture, including benches, planters, artwork, trees, water fountains, bollards, and cycle parking, to provide definition within the shared space and to delineate the travel lane from pedestrian-only areas.

Depending on the overall street width, consider providing a **1.8 m** wide, continuous clear path that is protected from traffic to ensure universal accessibility.

Install signage to educate the public on how to use a shared street in the early stages of conversion.

4. Light the streets evenly to create a safe and inviting environment. Light poles and fixtures for shared streets can be designed to add character and a sense of the local context. *See 7.3.1: Lighting Design Guidance.*

5. Include landscaping, such as planters and trees, where possible. Incorporate permeable pavers and rain gardens as a part of the larger green infrastructure and water-management strategies.

Use movable planters to restrict vehicular traffic access at certain times of the day.

Cities are encouraged to experiment with car-free hours or test shared streets using temporary materials to evaluate the potential impact on traffic operations.

Commercial Shared Streets | Example 2: 14 m

Existing | **14 m** | **40 km/h**

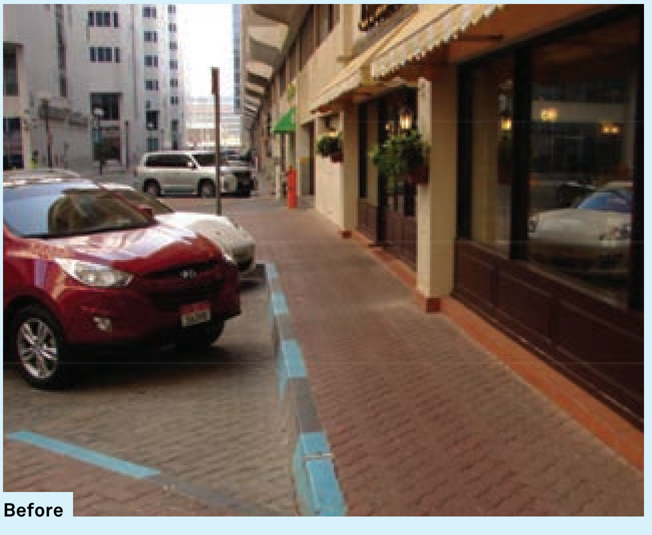
The illustration above demonstrates the same principles as outlined on the previous page in a different context with a wider street width.

Buenos Aires, Argentina. A busy commercial shared street where pedestrians and cyclists are given priority.

London, United Kingdom. Exhibition Road was transformed into a shared street through a design competition prior to the 2012 Olympics.

Redesign | 14 m | 10 km/h

ABU DHABI, UAE



Before

After

Redesign of existing city streets following guidance and standards in the *Abu Dhabi Urban Street Design Manual*, *Public Realm Design Manual*, and *Utility Corridor Design Manual*.

Fort Street; Auckland, New Zealand

CASE STUDY

Location: Auckland CBD, New Zealand

Population: 1.4 million
Metro: 1.5 million

Context: Mixed-Use (Residential/Commercial)

Right-of-Way: 19–20 m

Size: Area in and around Fort Street

Cost: 23 million NZD (16 million USD)

Funding: CBD Targeted Rate

Project Sponsors: Manager, CBD Projects, Auckland City Council

Speed: N/A - No posted speed

A Network of Shared Streets

Before

After

Photo: Auckland Council

The transformation of Fort Street into a shared street resulted in a 54% increase in pedestrian volumes and a 47% increase in consumer spending.

Overview

Fort Street showcases how shared streets can turn a district into a destination, increasing visitors for shopping and other activities.
It is one of several new shared spaces implemented in Auckland's Central Business District in recent years to enhance pedestrian connectivity and provide a high-quality public realm.

Goals

- Better integrate the area into the surrounding street network.
- Prioritize pedestrians.
- Create a distinctive public space.
- Create a space that supports businesses and residents and provides opportunities for a variety of activities.
- Provide a high-quality, attractive, and durable street that contributes to a sustainable and maintainable city center.

Keys to Success

Collaboration with key stakeholders.

Monitoring and evaluating the project before and after implementation in order to communicate its impacts.

Testing design variations.

Involvement

Public Agencies
Auckland Council, Auckland Transport

Private Group
Local business owners and operators

Citizen Associations and Unions
Blind Foundation

Designers and Engineers
Boffa Miskell, Jawa Structures, TPC (traffic engineering), LDP (lighting)

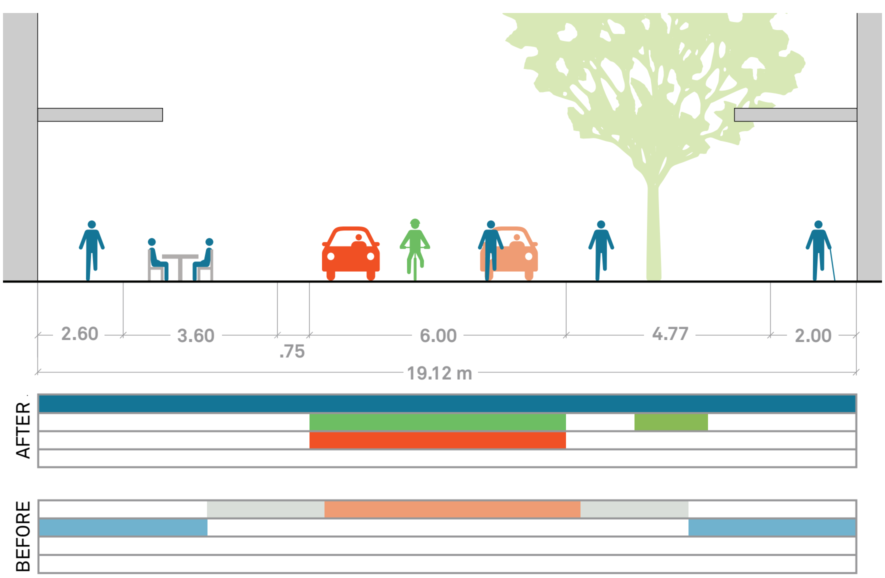
Evaluation

+54%
Increase in pedestrian volumes

+47%
Increase in consumer spending

-25%
Decrease in vehicle volume

+80%
Felt safer in the area



Key Elements

Removal of any demarcation between pedestrians and vehicles such as curbs and bollards.

Extended areas for open-air activities.

Pedestrians can use the entire right-of-way.

Accessible routes along building lines for the visually impaired.

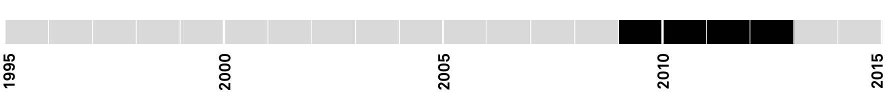
Removal of all parking spaces.

Restricted loading times.

Street furniture and landscaping.

Project Timeline

June 2009–April 2013



User Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking

10.4.2 | Residential Shared Streets | Example 1: 9 m

Existing | 9 m | 40 km/h

Low-volume residential streets, especially in older cities, may have narrow or nonexistent sidewalks. Many operate as de facto shared spaces in which children play and people walk and cycle, sharing the roadway with drivers. Depending on the street's volume and role in the traffic network, these streets have the potential to be redesigned as shared streets.

Existing Conditions

Buildings may have little or no setbacks, and drainage channels may run on both sides of the street, below or next to the sidewalks. In some contexts, these channels are uncovered.

Limited space can result in narrow and discontinuous sidewalks that are inaccessible and blocked by parking.

Shared streets may emerge as an existing condition informally, especially in suburban or largely unplanned residential settlements.

Pedestrian facilities on residential streets may be poor or entirely missing, with motor vehicles dominating the right-of-way.

The most accessible section of the street is often the center, where pedestrians may be discouraged from walking by pressure from motor vehicles.

Design Guidance

Transform streets with low vehicular volumes and high pedestrian activity into shared streets.

Treat this street as a slow street. Use vertical and horizontal deflections to slow driving speeds. *See 6.6.7: Traffic Calming Strategies.*

Use curbs and surface treatments that create unusual geometries to enhance the feeling of shared environments and encourage drivers to reduce speeds by diverting their path of travel.

Design shared residential streets to operate intuitively as shared spaces, where pedestrians are prioritized. Use signage to educate the public in the early stages of implementation. Residential shared street signage often depicts children playing to make motorists aware of entering a low-speed area.

1 Test designs with interim strategies and low-cost solutions. Movable planters, sculptures, street furniture, and designated parking may act as horizontal speed deflectors and help achieve the desired results.

2 Design clear gateways onto the shared street, with narrow vehicle path entries to slow vehicular traffic to appropriate speeds. Use grade changes, paving textures and colors, and tactile strips to alert pedestrians when they are crossing out of the shared street into general traffic space.

Designate zones for parking, landscaping, and flexible activities to create a chicane condition and slow vehicular traffic. Flexible zones allow streets to be used by residents as an extension of their homes, as play zones by children, and as cycle parking.

Maintain a clear path for cars and cycles. The path can be defined using landscape, street furniture, parking zones, street utility poles, or textured pavers.

Use textures and street furniture to reinforce priority for pedestrians.

3 Change materials and colors to demarcate different zones. Parking zones must be clearly marked to avoid unregulated parking.

Provide drainage channels at the center of the street or along the flush curb, depending on underground utilities and other existing conditions.

Select pavings, material, and furniture based on regional climate and durability. Opt for snow-compatible materials for colder climates or permeable pavers for places with high rainfall. *See 2.9: Implementation and Materials.*

Residential Shared Streets | Example 2: 10 m

Existing | **10 m** | **40 km/h**

The illustration above demonstrates the same principles as outlined on the previous page but in a different context and with a wider street width.

New Delhi, India. Many residential streets function as shared spaces by default, doubling as social spaces to gather and play.

Amsterdam, The Netherlands. Dedicated play spaces help to share the street between all users and horizontally deflect vehicles to calm traffic.

Copenhagen, Denmark. The Potato Rows, or Kartoffelraekkerne, has play structures, landscaping, and picnic tables in the street.

Malmö, Sweden. The Bo01 neighborhood incorporates cycle parking, green infrastructure, and furniture to slow vehicles and prioritize people.

CASE STUDY

Van Gogh Walk; London, United Kingdom

Location: Stockwell, Borough of Lambeth, London

Population: 8 million
Metro: 13.8 million

Length: Approx. 100 m–2 blocks

Right-of-Way: 12 m

Context: Residential

Cost: 700,000 GBP (110,000 USD)

Funding: Lambeth Council

Speed: N/A - No posted speed

Before

After

Photo(Before): Elaine Kramer

The bottom-up process put in place by the local nonprofit guaranteed community involvement and support during the creation of this residential shared street.

CASE STUDY

Overview

Van Gogh Walk, previously Isabel Street, is the centerpiece of a resident-led project in Stockwell, a district in south London. This project has transformed a traditional street into a new shared street and community space.

Funding for the street transformation was allocated by the borough council and obtained by a local nonprofit called Streets Ahead. It captured the future value of planning gains for the improvement of neighborhood streets.

Isabel Street was a 12 m wide residential street, lightly trafficked, and often used as a play area by neighborhood children.

Most surrounding properties are residential units without gardens, and the nearest park is some distance away, creating a demand for public space.

Goals

- Provide a space for children to play and residents to meet.
- Compensate for the lack of public open space in the area.
- Enhance pedestrian safety and activity.
- Foster neighborhood interaction and outdoor activity such as gardening.
- Encourage non-motorized transportation.

Involvement

Public Agencies
Lambeth Council

Citizen Associations and Unions
Streets Ahead

Designers and Engineers
Shape (Landscape Architect),
FM Conway (Contractor)

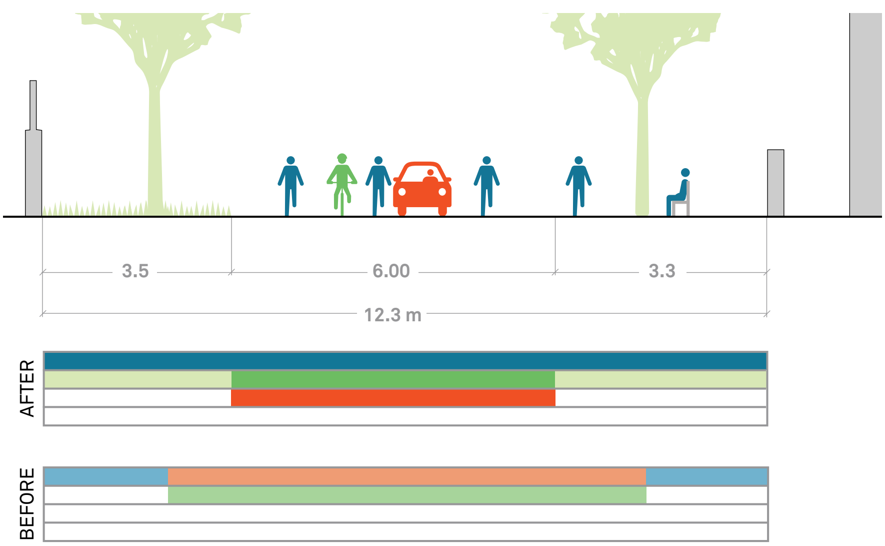
Keys to Success

The bottom-up process put in place by the local nonprofit guaranteed community involvement and support.

The project occupied an underutilized roadway, where most of the street space was previously allocated to cars.

The area was lacking quality open space and areas for children to play.

The project formalized pre-existing informal public uses.



Key Elements

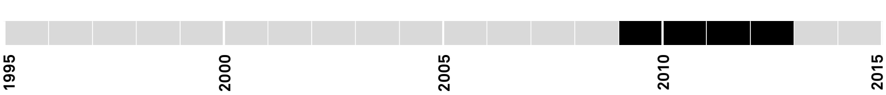
Removal of any demarcation between pedestrian and vehicles.

Pedestrians can use the entire right-of-way.

Extended areas for open-air activities, including play and gardening areas.

Project Timeline

2009–2013



User Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape

10.5 Neighborhood Streets

Neighborhood streets are where communities are built. They are the front doors to homes, schools, stores, restaurants, and extensions of parks and playgrounds. They are places where people spend time, children play, and neighbors meet.

The main streets, or high streets, provide access to local services while offering mobility choices that connect them to other parts of the city. Often vibrant and bustling with commercial activity, the primary corridors move significant volumes of people every day and may host special events and markets. The adjacent residential areas, however, generally have quieter streets that invite traffic to move at slower speeds.

Well-designed sidewalks, provision of cycle facilities, shade trees, and traffic calming measures ensure that people are invited to walk or cycle to local destinations through these neighborhood streets.

New York City, USA

10.5.1 | Residential Streets | Example 1: 13 m

While density and sizes vary, local streets in residential neighborhoods are often underutilized as spaces for play and leisure. These streets should provide safe and inviting places to walk and access to local stores and schools. Designs for local residential streets should combine stormwater management features. Curb extensions and traffic calming measures must be applied to slow vehicles through vertical and horizontal speed-control elements. Safe cycling environments should be provided on all streets.

Existing Conditions

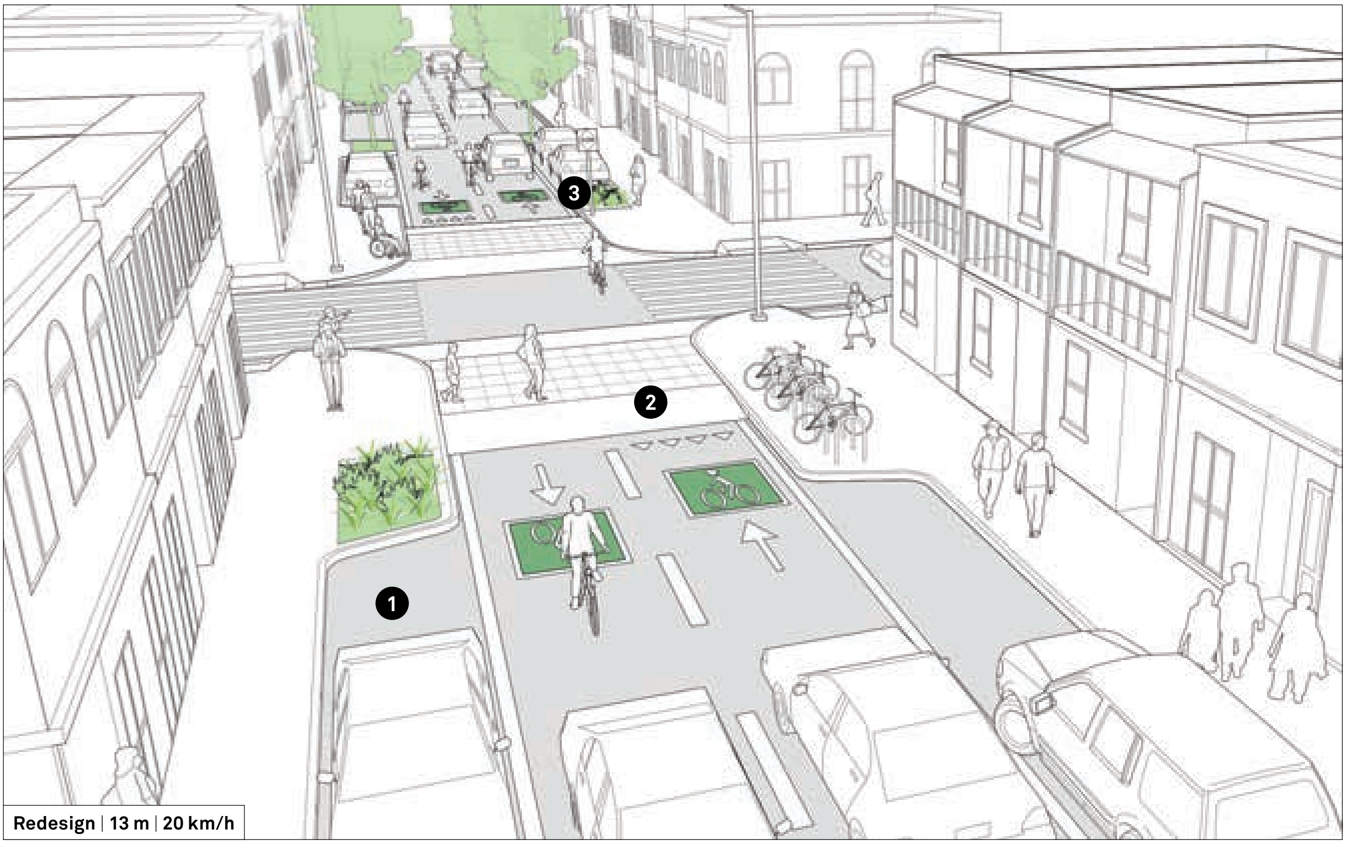
This illustration shows a two-way residential street with parking on both sides.

Residential streets might be designed with minimal sidewalks, limited vehicular access, and low volumes, allowing them to operate informally as slow zones.

Varied conditions on either side of the street are characterized by absent or cluttered sidewalks, and parallel or perpendicular parking.

To maintain low speeds and volumes on these streets, poorly designed speed bumps might occasionally be installed.

Fortaleza, Brazil. Before and after images showing a residential street transformation using traffic calming measures.



Design Guidance

Maintain one travel lane in each direction with a maximum of **3 m** lane width. *See 6.6.4: Travel Lanes.*

Design sidewalks to provide accessibility ramps and continuous unobstructed clear paths.

This configuration has tight dimensions due to restricted space. When more space is available, or the amount of parking can be reduced, allocate additional pedestrian space for a better walking environment with landscaping and street furniture.

1 Alternate curb extensions and rain gardens with parking spaces to create pinchpoints on the streets, which help in speed reduction.

Utilize these curb extensions to locate street trees, light poles, cycle racks, and other street furniture.

Cyclists can ride safely in mixed traffic when streets are designed for 20 km/h. *See 9.1: Design Speed.*

Sydney, Australia

2 Introduce raised crosswalks at the intersections, which act as speed calming measures and prioritize pedestrians. *See 11.5: Small Raised Intersection.*

3 Support traffic calming strategies with clearly marked speed limits.

Residential Streets | Example 2: 16 m

Existing | 16 m | 40 km/h

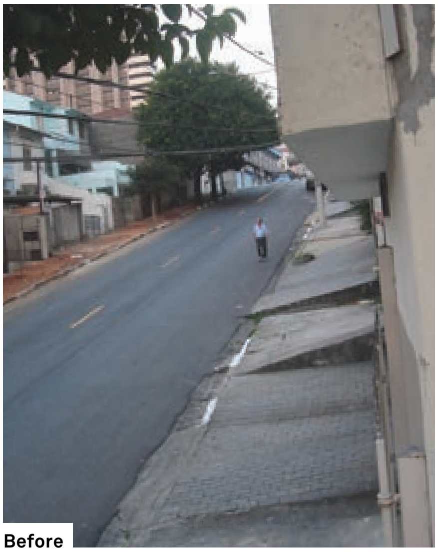
Existing Conditions

This one-way residential street has unregulated curbside parking and wide travel lanes that encourage speeding and render the street unsafe for vulnerable users.

Sidewalks are discontinuous or non-existent, resulting in a lack of accessibility for pedestrians. Driveway ramps, stoops, light poles, and other utilities create frequent obstructions.

Drainage channels run on both sides of the street, either under or next to the sidewalks. In some places, these channels might be uncovered.

Lack of shade and uneven lighting make the street unappealing during hot weather and at night.



Before

After

Sao Paulo, Brazil.

Design Guidance

Transform the street by removing one travel lane, improving sidewalks, and adding a contraflow cycle lane.

1 Avoid perpendicular parking. Provide parallel parking with narrower width to use space efficiently. Alternate parking spaces with dedicated areas for utilities, street furniture, and landscaping to help maintain a clear pedestrian path on the sidewalk.

Since the buildings on this street have minimal setbacks and stoops that extend into the sidewalk, the reconstruction accommodates widened and accessible sidewalks on both sides.

2 Allow cycles in both directions to facilitate a permeable and connected cycle network. In this example, cycle-priority ground markings are added in the travel lane, and a dedicated cycle track runs in the opposite direction.

3 Traffic calming strategies slow vehicular speeds to **20 km/h**, ensuring a safe environment for pedestrians, cyclists, and motorists. Add speed tables at the intersections to facilitate raised crossings and prioritize pedestrians.

Use different paving materials and color markings to distinguish cycle lanes from the travel lane. Road markings may be added.

4 Incorporate green infrastructure strategies by using permeable pavers, rain gardens, and street trees. *See 7.2: Green Infrastructure.*

This street transformation is recommended when there is a need to upgrade existing utilities and underground services or lay new ones. *See 2.8: Coordination and Project Management.*

Copenhagen, Denmark. Contraflow cycle lanes on a one-way street.

Residential Streets | Example 3: 24 m

Existing | 24 m | 60 km/h

Existing Conditions

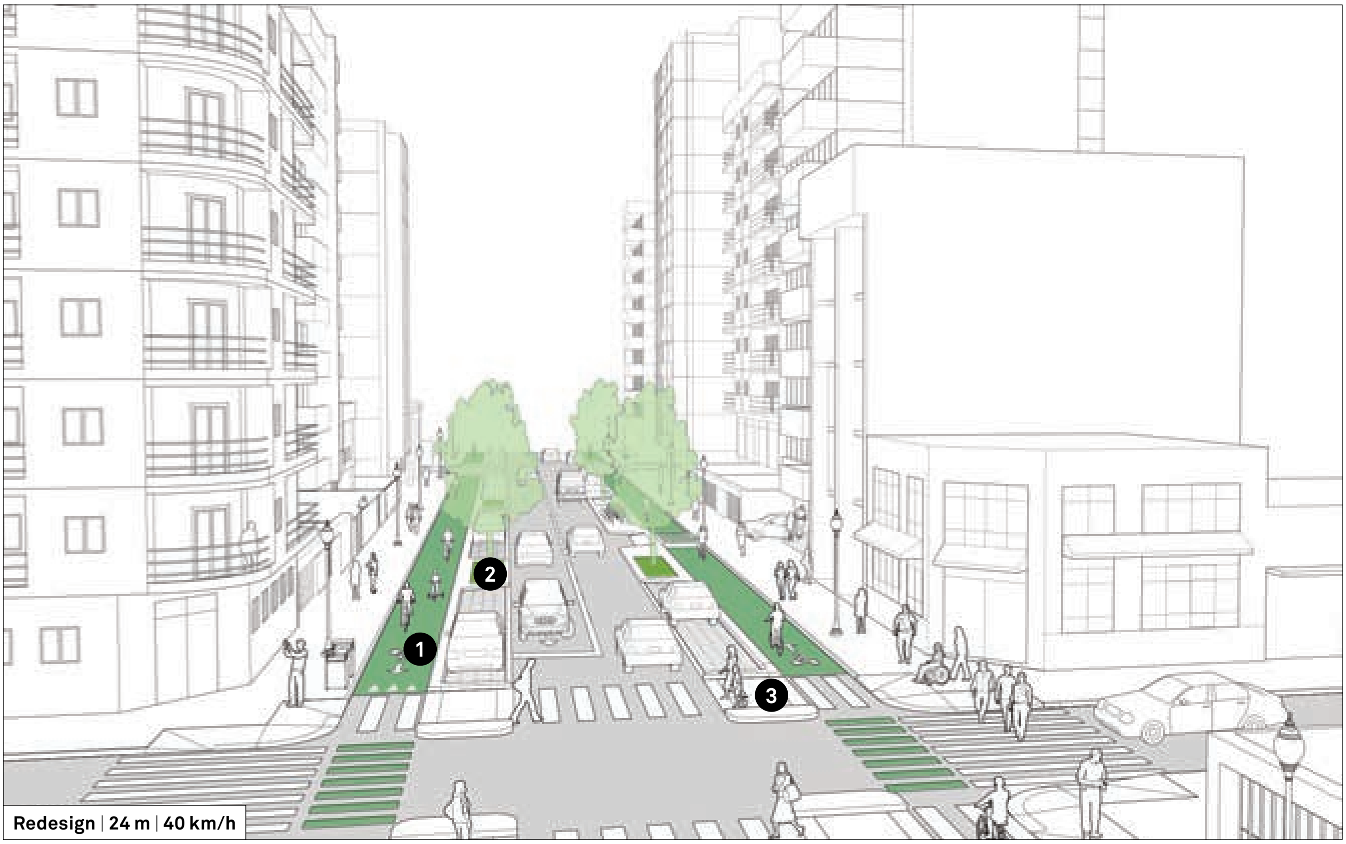
This illustration depicts a two-way street in a high-density neighborhood. The street serves local traffic and some through traffic.

Two wide travel lanes in each direction encourage speeds that are not appropriate for residential streets. Parallel parking is provided on both sides of the street.

Lack of trees, drainage, or green infrastructure results in unshaded sidewalks and water pooling during heavy rains.

Cyclists share the travel lanes with motorized vehicles.

Fortaleza, Brazil. Water pooling due to a lack of drainage or green infrastructure.



Design Guidance

Remove one travel lane in each direction and reduce lane widths to **3 m**.

1 Add protected cycle tracks by locating them between the curb and the offset parking lane. Provide these dedicated cycle facilities on each side and connect to other facilities to extend the citywide cycling network. *See 6.4.4: Cycle Facilities.*

2 Alternate parking spaces with trees or rain gardens. Use permeable paving for the parking lane and introduce rain gardens to increase permeability, improve stormwater management, and reduce urban heat island effect.

3 Align pedestrian islands with the parking spaces to protect pedestrians waiting to cross the street.

Place all street lighting, cycle racks, and utility boxes along a common curb zone to create a continuously accessible clear path.

Add accessibility ramps and tactile strips, and maintain existing sidewalk widths. *See 6.3.8: Universal Accessibility.*

Ensure that all curb cuts and driveways are designed with appropriate ramps for minimal disturbance to the pedestrian clear path.

Auckland, New Zealand. Parking is spaced between green infrastructure elements.

Bourke Street; Sydney, Australia

Location: Woolloomooloo Bay, Darlinghurst, Surry Hills, Sydney

Population: 4.8 million

Length: 3.4 km

Right-of-Way: 20 m

Context: Mixed-Use (Residential/ Commercial) Main Street

Cost: 24 million AUD (18.5 million USD), including ground services and streetscape improvements

Funding: City of Sydney Council

Max. Speed: 40 km/h

Overview

Bourke Street is Sydney's first large-scale bidirectional, separated cycle track, and is part of the city's strategy to increase the quality and scope of the cycle network in the Sydney area.

The 3.4 km project is an upgrade of an existing cycle route connecting Cowper Wharf Road in Woolloomooloo Bay to Phillip Street, Waterloo. The design provides improved safety and amenities for cyclists and pedestrians.

Boarding Island

Parking Protected Cycle Track

T-Intersection

Photos: City of Sydney

Cycle training and behavior change programs were organized to promote a cycle-positive culture and to acclimatize users to a new and shared use of public space.

Key Elements

Separation. A cycle track separated from motorists and pedestrians, located between the sidewalk and parked or moving vehicles.

Protection. Physical barriers such as medians, curbs, buffer planting, and rain gardens maximize separation from motorists and pedestrians, providing cyclists with a sense of protection while also improving the pedestrian experience.

Lane Narrowing. Appropriate lane widths calm vehicle traffic and recapture the right-of-way for walking, cycling, and beautification.

T-Intersections. Low-volume T-intersections at side streets resulted in the development of a "Shared Environment Intersection." This design gives the right-of-way to pedestrians, and provides equivalent rights to cyclists and motorists within the intersection.

Lessons Learned

Being the first of its type in an established conservation area, there was small vocal opposition regarding the possible loss or damage to heritage protected trees, potential loss of car parking, potential injury to cyclists by car doors, and possible injury to pedestrians by cyclists.

Cycle training and behavior change programs along busy cycle routes promote a cycle positive culture and acclimate users to a new and shared use of public space.

To ensure a safe environment and maintain an amenity for pedestrians and residents, the following measures provided an integrated urban intervention:

- Reduced speed limit to 40 km/h, installing traffic calming devices, and removing road center lines to reduce vehicle speed.
- Installed curb extensions to increase sight lines and reduce pedestrian and cycle crossing distances.
- Improved streetscape and cycle route lighting.

Keys to Success

Political leadership of the City of Sydney Council.

Experienced professional leadership and management within the City of Sydney Council.

Experienced consultants.

Collaborative partnership with the Roads Authority.

Motivated civil contractors.

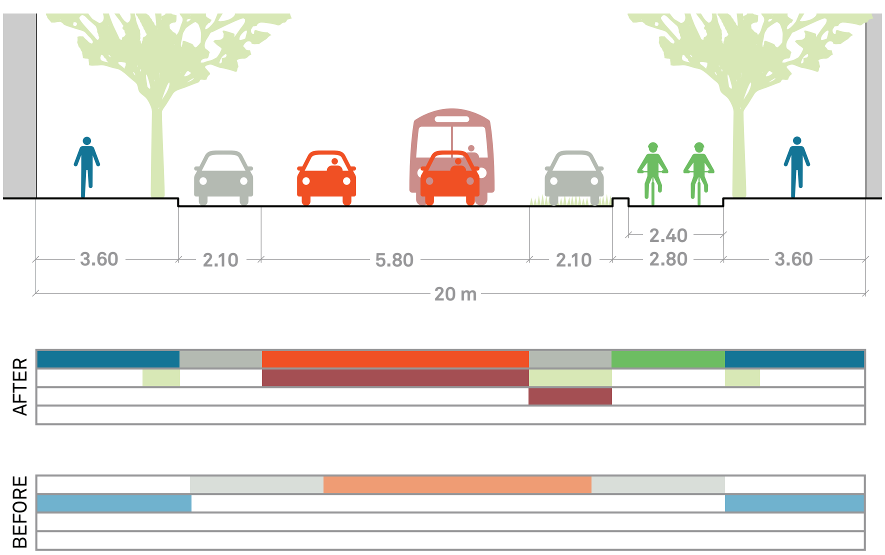
Involvement

Public Agencies
The City of Sydney Council, Sydney Buses, Roads and Maritime Services

Private Group and Partnerships
Local business and retailers

Associations and Nonprofits
Bike Sydney

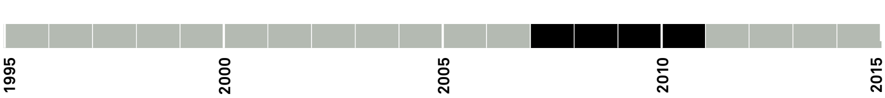
Designers and Engineers
Group GSA, GTA Consultants, and Northrop



Users legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking

Project Timeline

2007–2011 (4 years)

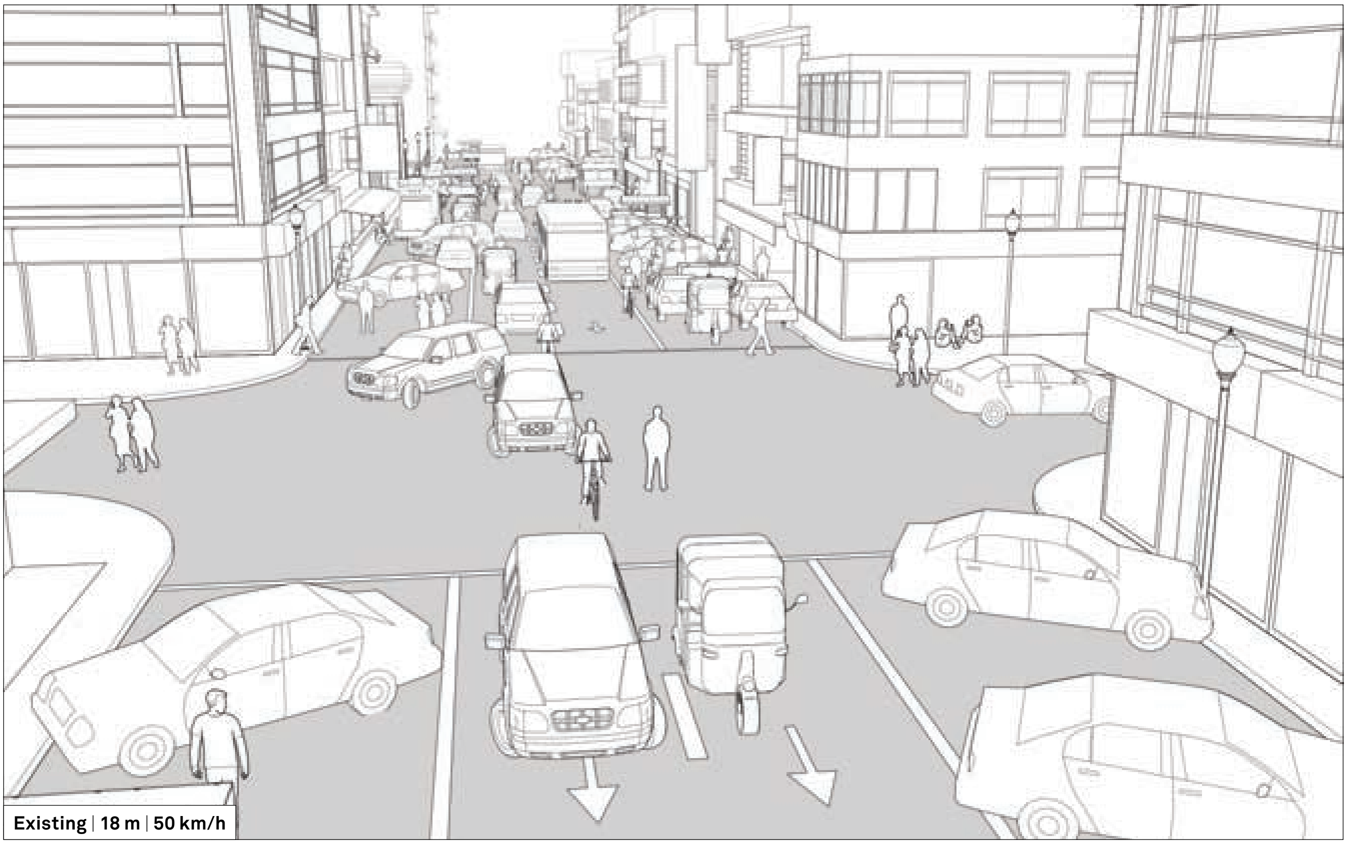


Evaluation

+408%

Increase in cycle volume between March 2010 and March 2014

10.5.2 | Neighborhood Main Streets | Example 1: 18 m



Neighborhood main streets lie at the heart of everyday life, offering walkable destinations such as restaurants, shops, services, and transit stops. Pedestrian volumes should be accommodated by well-designed sidewalks. Traffic speeds should be limited, and key transit routes and cycle lanes prioritized. These streets must be redesigned to better serve the needs of multiple users.

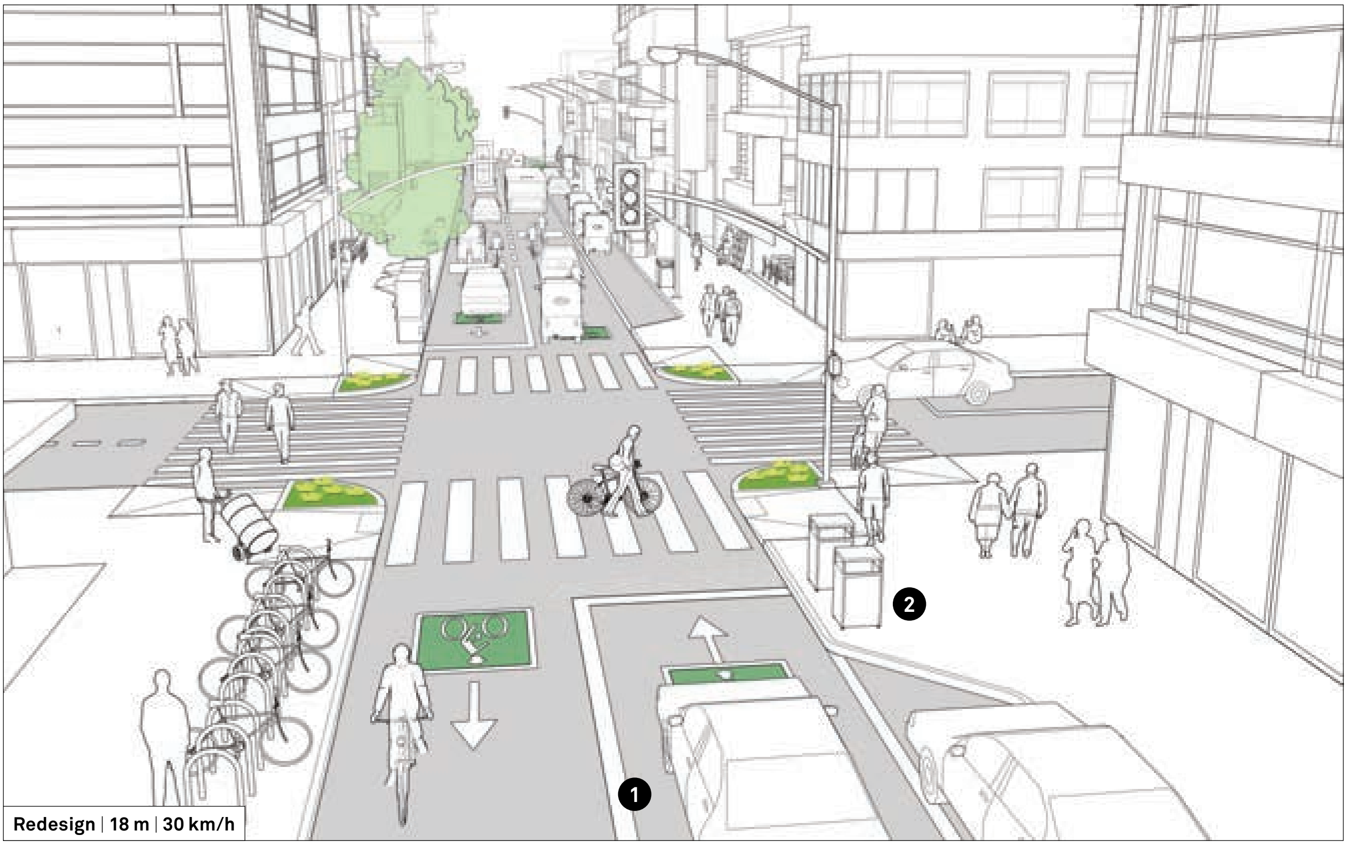
Existing Conditions

This example illustrates a main street with two travel lanes in the same direction and unregulated parking on both sides.

Instead of serving the many functions that a neighborhood street should, the entire right-of-way is dedicated to moving and parked vehicles.

Pedestrians have little choice but to walk on the roadbed and are exposed to unsafe conditions, as they weave through fast-moving traffic and face cars turning at high speeds.

Prishtina, Kosovo



Design Guidance

Reduce parking and replace it with extended sidewalks and intermittent parallel parking to make the street more inviting.

Lower parking demand can be encouraged by area-wide demand management strategies, including parking pricing.

1 Following larger network analysis, convert this one-way street into a two-way street, to improve transit connectivity and to reduce speeds. Free turns may be restricted to certain corridors to reduce risk of conflicts for pedestrians crossing the street.

2 Add curb extensions to provide additional public space and create pinchpoints at intersections, which slow turning traffic. *See 6.3.7: Sidewalk Extensions.*

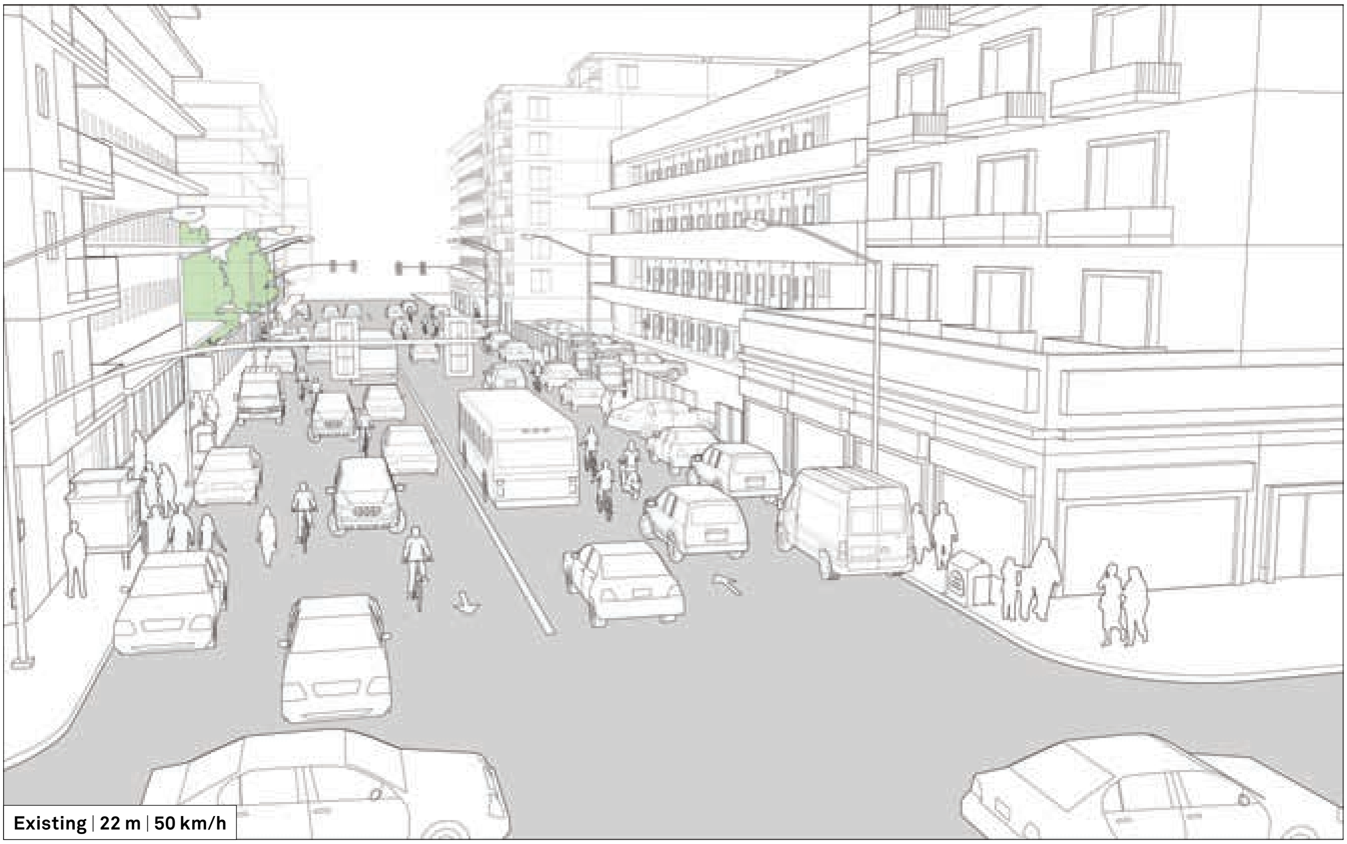
Add road markings to indicate shared travel lanes with priority for cyclists.

Plant trees strategically such that they do not impact visibility for pedestrians or obstruct the clear path.

Over time, consider removing private cars to transform this narrow street into a transit mall that prioritizes transit, pedestrians, and cycles.

San Francisco, USA

Neighborhood Main Streets | Example 2: 22 m



Existing Conditions

This illustration depicts a neighborhood main street with excessive travel lanes and curbside parking, which fosters a chaotic and auto-centric streetscape. The street is used as a through-way and not as a destination.

Some buildings provide active frontage, while others are set back to accommodate parking.

São Paulo, Brazil

New Delhi, India

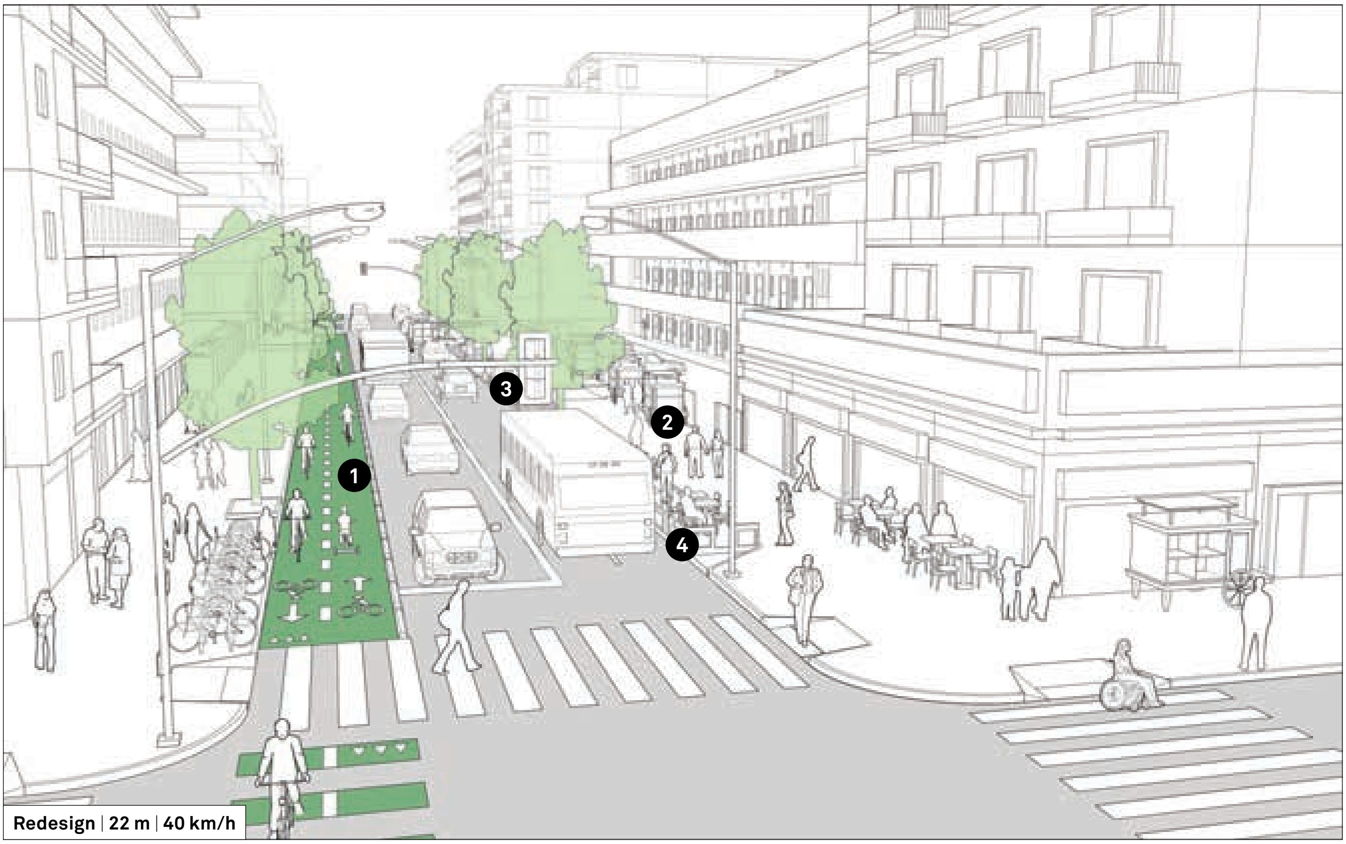
Such streets might have narrow sidewalks, having been designed primarily for motorists.

Long stretches of fencing along property edges detract from the pedestrian experience and make walking distances seem farther than they are.

Wide travel lanes with narrow medians and a lack of organization and striping invite speeding and double parking.

A lack of dedicated cycle facilities puts cyclists at great risk, especially with high traffic volumes.

In some cases, utilities and services may block clear walking paths. The sidewalks and the adjacent roadbed may be encroached on by unregulated car parking, street vendors, and rickshaws, forcing pedestrians onto the roadbed.



Design Guidance

The street is transformed by removing a travel lane in each direction, adding protected cycle lanes, and widening the sidewalks to encourage multiple mobility options.

1 Configure a bidirectional cycle track on one side when the right-of-way width is limited. Vertical elements separating the cycle track are essential to preventing incursions and providing a high level of comfort. *See 6.4.4: Cycle Facilities.*

Widen sidewalks to provide space for vendors, street furniture, artwork, and trees that activate and revitalize the street edge.

2 Locate active uses such as vendors along blank building walls, parking spaces, or fences in order to improve the pedestrian experience. *See 6.8: Designing for People Doing Business.*

Montreal, Canada

3 Provide parallel parking on one side of the street, alternating with trees and green infrastructure. Eliminate parking at intersections and extend curbs to improve safety and increase visibility.

4 Use selected parking spaces for parklets to provide additional public space. *See 10.3.3: Parklets.*

For blocks larger than 100 m, design mid-block crossings between key destinations to increase permeability. *See 6.3.5: Pedestrian Crossings.*

Lima, Peru. A parklet increases the public space available for people to enjoy with low-cost seating, paint, and recycled materials.

Neighborhood Main Streets | Example 3: 30 m

Existing | 30 m | 60 km/h

Existing Conditions

The illustration depicts a neighborhood main street with a very wide roadbed and unregulated parking on both sides. This street connects the outskirts with the city center, serving primarily as a vehicular thoroughfare.

Angled parking increases the turning radius at the intersection, encouraging fast turns and reducing visibility. Pedestrian crossings are not marked or signalized.

Motorists often fail to yield to pedestrian crossings. These conditions expose vulnerable users to conflicts.

Addis Ababa, Ethiopia

Cars moving in and out of parking spaces block travel lanes and create dangerous conditions for cyclists. This is also a common cause of rear-end collisions.

Transit riders are forced to disembark into the road because parked cars block the bus from accessing the bus stop.

Charleston, USA

Sidewalks are inaccessible and often blocked or interrupted by parked cars, utility poles, street vendors, and other furnishings.

Some ground floor uses, such as loading, spill out onto the sidewalk, obstructing the clear path.

Design Guidance

Redesign the street to better serve the needs of all users. Protected cycle tracks, curb extensions, transit stops, and widened sidewalks distribute the space more equitably to encourage walking, cycling, and transit use.

Reduce the roadbed to one travel lane in each direction and convert angled parking into parallel parking.

1 Allow transit vehicles to share the travel lanes with cars and provide island stops for fast, accessible boarding.

2 Mark protected cycle tracks at conflict zones such as mid-block crossings, curb cuts, and through intersections.

3 Alternate parking spaces with other services and uses such as refuge islands, sheltered transit stops, cycle-share stations, rain gardens, and wider loading bays for trucks.

Add a raised, mid-block crossing to increase permeability and support a safer pedestrian environment.

4 Widen sidewalks to allow multiple activities to take place on the street without obstructing the clear path. Plant trees, install street furniture, and create an improved public realm that supports local businesses.

Install ramps and tactile strips to make sidewalks and crossings accessible.

5 Adopt green infrastructure strategies, including rain gardens and permeable paving, to improve water management and reduce water stagnation in low-lying areas. *See 7.2: Green Infrastructure.*

Copenhagen, Denmark

CASE STUDY

St. Mark's Road; Bangalore, India

Location: Bangalore, India

Population: 8.42 million

Context: Central Business District

Right-of-way: 18–20 m (on average)

Length: Approximately 1 km

Cost: 1.15 billion INR (20 million USD) for the first phase

Funding: Public

Max. Speed: 40 km/h


Before


After

Photo: Jana Urban Space

Context Map

The street challenges were addressed using a comprehensive and multidimensional approach: break once, and fix once and for all.

Overview

The reconstruction of this one-way street addressed several major challenges, including inadequate design and planning, poor maintenance standards, and inefficient utility management. The project took a comprehensive, multidimensional approach under the program Tender S.U.R.E.: break once, and fix once and for all. This approach promotes upfront investment in quality materials and construction to increase durability.

Goals

- Balance existing uses.
- Enhance user experience, increase pedestrian safety, and calm traffic.
- Reduce disruptive construction practices by investing in upfront, quality construction for long-term durability.

Keys to Success

- Interagency coordination.
- Public participation and involvement from the early stages of the project.
- Documentation and verification of existing utilities as part of planning and design process.

Involvement

Public Agencies
Government of Karnataka, Bangalore Municipal Corporation (BBMP), Bangalore Development Authority, KPTCL, Traffic Police, Bangalore Metropolitan Transport Corporation (BMTC), BESCOM

Nonprofit Organizations
Jana Urban Space, Janaagraha Centre for Citizenship and Democracy

Designers and Engineers
Jana USP (Designer), NAPC (Contractor)

Evaluation

+250%

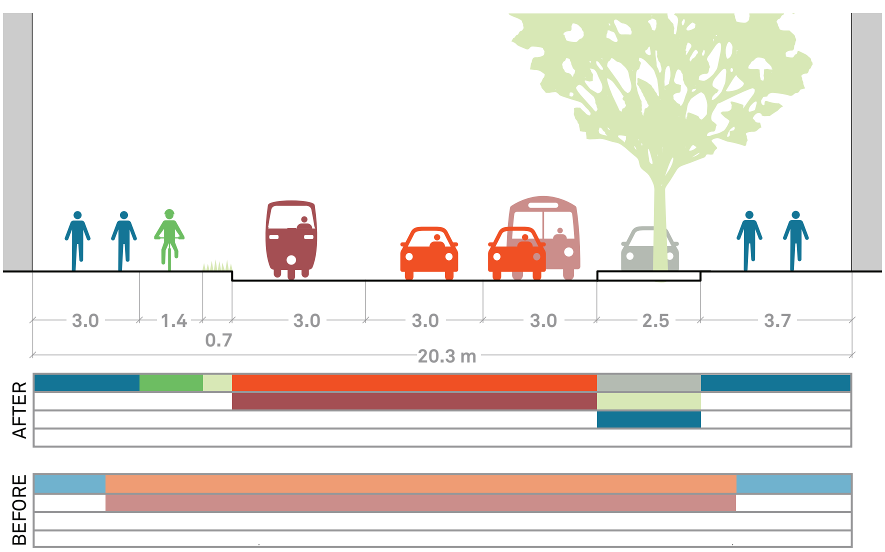
Increase in pedestrian volume

-3 min.

Wait time at pedestrian crossings reduced from 5 minutes to 2 minutes

12 sec.

Pedestrian crossing time reduced to 12 seconds, with shorter crossing distances



Key Elements

Enhanced and extended sidewalks.

One-way protected cycle tracks.

Consistent travel lanes.

Dedicated and paved bus, auto rickshaw, and parking bays.

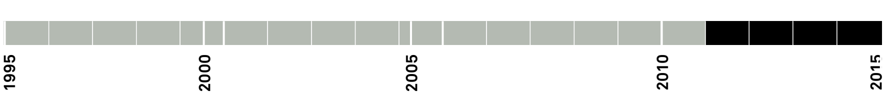
Landscaped strip between the motorized and non-motorized paths.

Protection and enhancement of existing trees with pits and guards.

Reconfiguration of underground utilities with the creation of access chambers for utility lines.

Project Timeline

2011–2015 (4 years)



User legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking

10.6

Avenues and Boulevards

The grand streets of a city play a critical role in moving people from one neighborhood to another and connecting to central areas. These include large iconic boulevards, downtown shopping streets, distinctive avenues, transit streets, or central thoroughfares lined with commercial activities. Grand streets are often designed with the primary goal of moving a large number of vehicles at relatively high speeds, creating a daunting environment for pedestrians and cyclists. They divide neighborhoods, reduce the quality of the public realm, and reduce the potential value of adjacent properties.

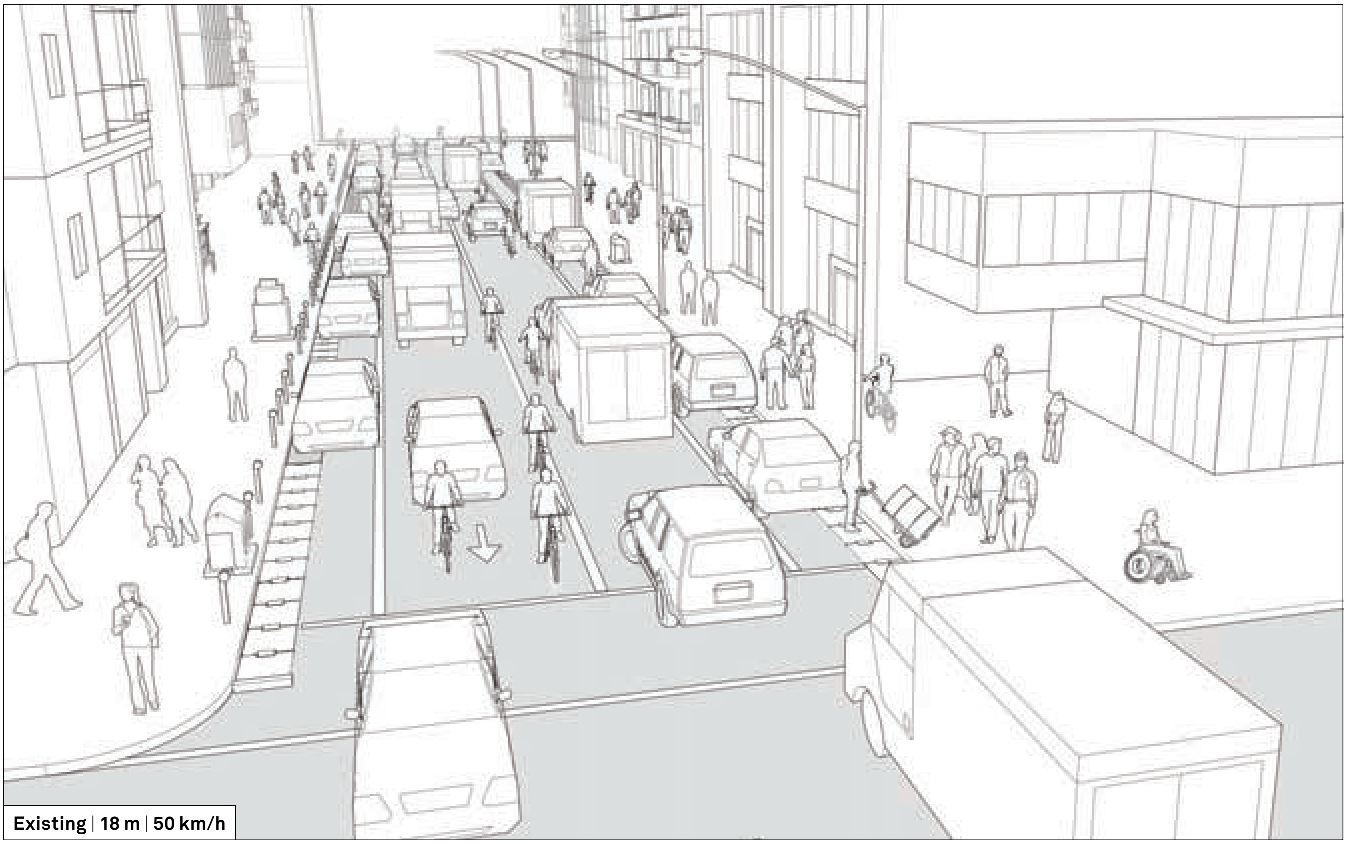
As grand streets typically include some of the widest and most continuous streets in a city, they offer ideal opportunities to create multimodal corridors that reconnect neighborhoods and communities.

Prioritizing sustainable transit through street design increases the street's capacity to move more people and creates more space for additional activities. Such streets can accommodate commercial activity, improved public spaces, and sustainable environments that benefit the surrounding communities.

Design grand streets to support their immediate contexts and desired future conditions.

São Paulo, Brazil

10.6.1 | Central One-Way Streets | Example 1: 18 m



Existing | 18 m | 50 km/h

During the last century, many cities converted central two-way streets to one-way operation in an effort to streamline traffic flow and reduce conflicts. Other cities were originally designed with one-way street grids for the same reason. Wide, one-way streets provide an opportunity to reconfigure broad roadbeds with cycle tracks and transit lanes, or to consider conversion into two-way operation for increased access, connectivity, and safety.

Existing Conditions

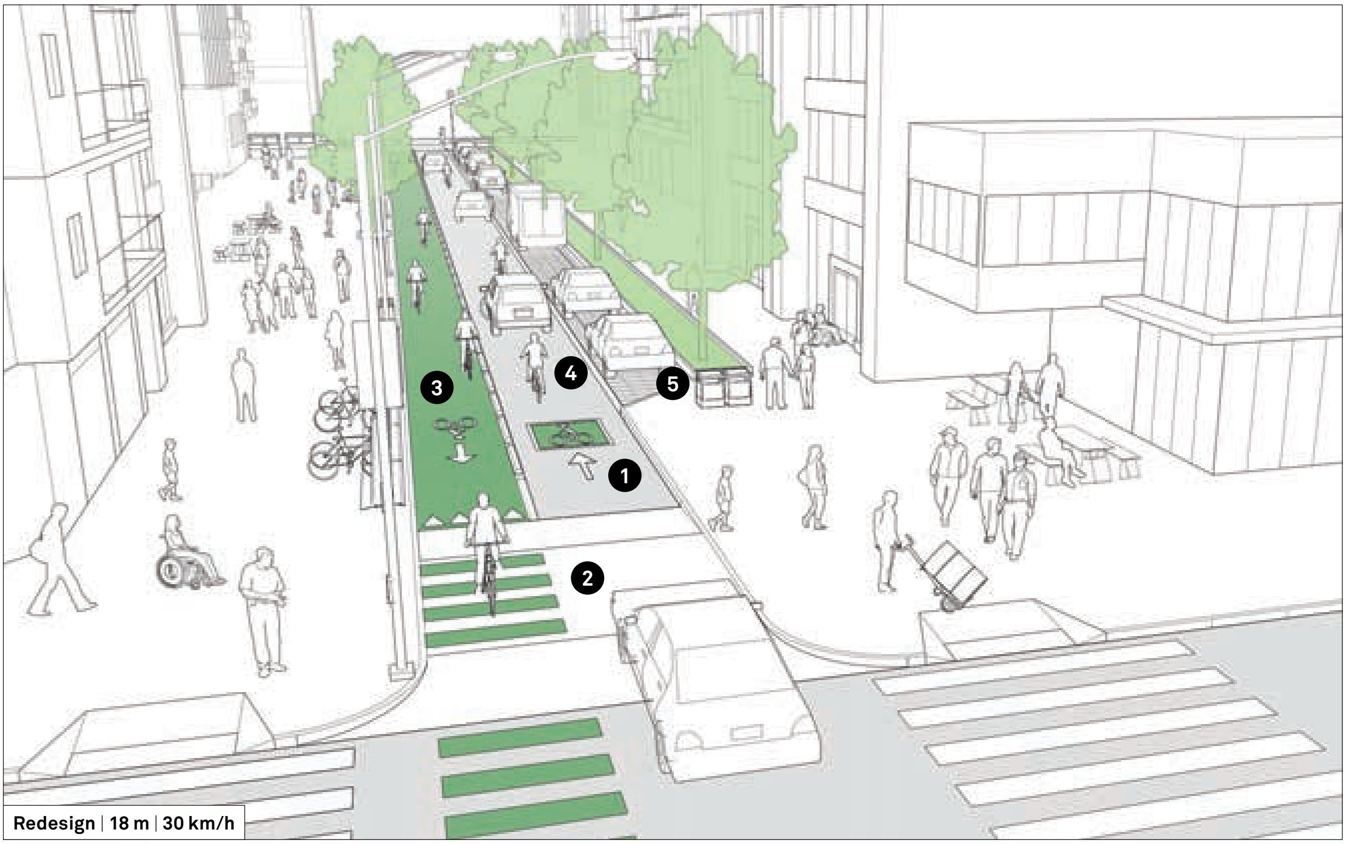
The above illustration depicts a two-way street with one travel lane in each direction, with mixed traffic and parking on both sides.

Frequent destinations on both sides of the street invite parking, stopping and loading that result in weaving traffic and turning conflicts.

A lack of cycle facilities encourages cyclists to ride on sidewalks, creating safety concerns for pedestrians.

Partially concealed drainage channels on both sides of the street present hazards to pedestrians and cyclists.

Bandung, Indonesia



Redesign | 18 m | 30 km/h

Design Guidance

1 When constrained two-way operation does not safely accommodate all users, consider conversion to one-way operation, allocating excess road width for pedestrians and cyclists.

2 Reduce travel lane width to **3 m** in order to avoid speeding. Add raised crossings at intersections to prioritize pedestrians and ensure slow traffic speed. *See 6.6.7: Traffic Calming Strategies.*

Widen sidewalks to accommodate commercial activity while maintaining the pedestrian clear path. *See 6.3.4: Sidewalks.*

3 Repurpose the opposing travel lane as an exclusive, raised contraflow cycle track. Contraflow cycle paths are especially important where the cycling network would otherwise require cyclists to significantly detour. *See 6.4.2: Cycle Networks.*

4 Create a shared travel lane with vehicles and cycles in the same direction, with a maximum travel speed of **30 km/h**.

5 Add green infrastructure such as permeable paving under parking spaces, rain gardens, and trees along the sidewalk to help manage stormwater and make the street more appealing.

Parklets should be encouraged to provide additional public space.

Chennai, India

Central One-Way Streets | Example 2: 25 m

Existing | 25 m | 60 km/h

Existing Conditions

This illustration depicts a one-way street with intensive commercial activity and local markets, disorganized through-traffic, and unregulated parking.

Insufficient sidewalk space forces commercial activity, vendors, and pedestrians to spill onto the roadbed and into parking lanes.

A lack of crosswalk markings creates an unsafe environment for vulnerable users. High curbs and no pedestrian ramps prohibit universal access.

Unregulated perpendicular parking on both sides of the curb reduces safety and causes delays as cars park into the travel lanes. Small collective transport vehicles often block traffic with passengers boarding and alighting.

This street may have been converted into one-way operation to accommodate increased volume, but it remains congested due to the lack of space allocated for other uses.

Hong Kong, China

Design Guidance

The street is transformed by redistributing the space in a balanced and equitable way.

1 Introduce a dedicated transit lane. Transit can be accommodated in a marked transit lane or in a fully separated curbside transitway. Small structured dividers are located before intersections to prevent vehicle incursions. *See 6.5.4: Transit Facilities.*

2 Ensure that transit stops do not obstruct the sidewalks and are placed in either the parking lane or in the landscaping zone.

Install a parking-protected cycle track to create a safer environment for cyclists. Provide a raised buffer to protect cyclists from dooring.

Provide cycle-share stations to help reduce vehicular traffic and the need for parking. *See 6.4.5: Cycle Share.*

3 Widen sidewalks to provide accessibility and increased space for pedestrians and commercial activity. Alternate parking spaces with additional curb extensions, intermittent landscaping, and dedicated spaces for vendors.

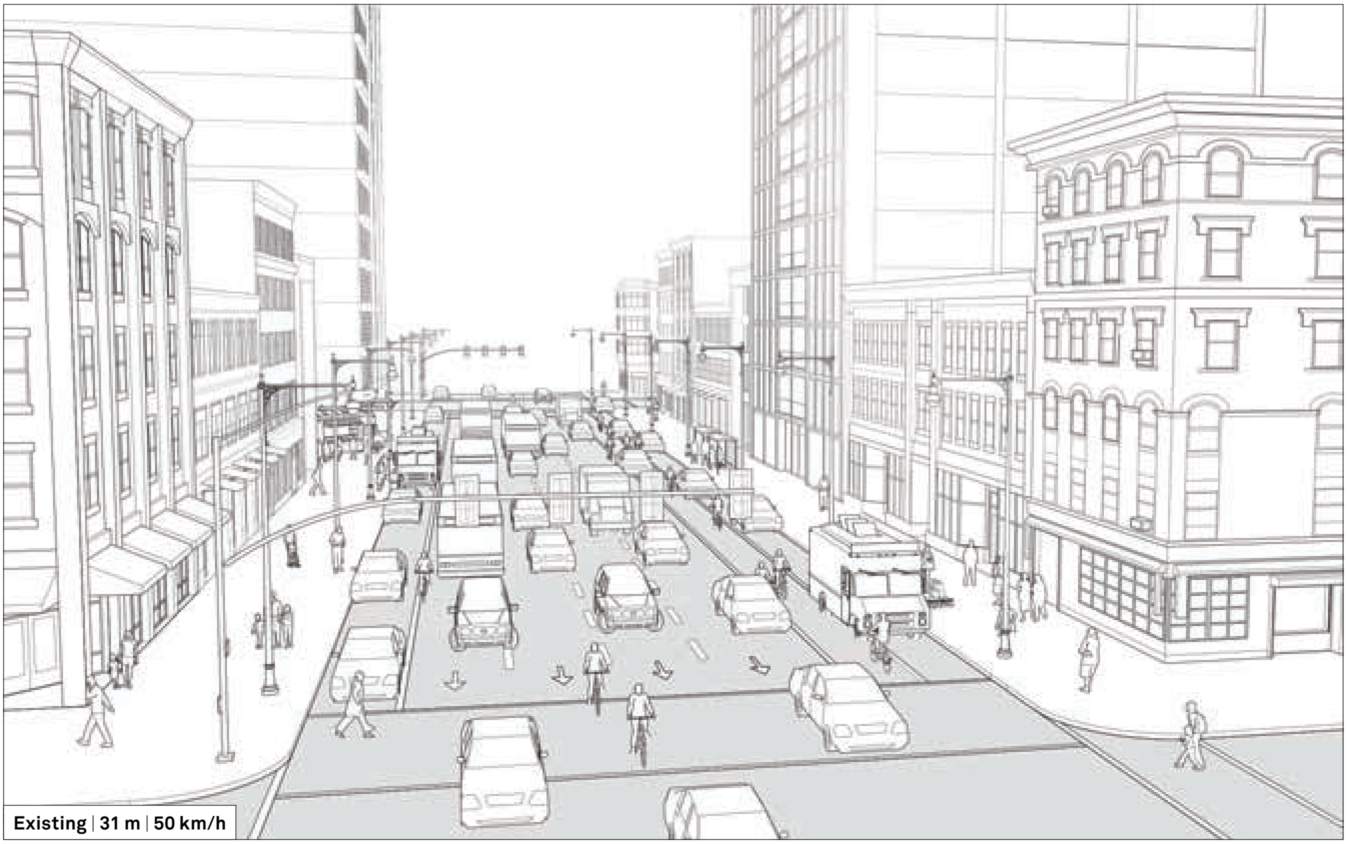
Bury utility lines below grade during reconstruction. *See 7.1: Utilities.*

Consider developing a local permitting process with siting guidelines for vendors. Ensuring that guidelines are enforced and spaces are well-maintained, clean, and free of obstructions will benefit vendors and pedestrians.

Allow wider parking spaces at strategic locations to create loading bays. Restrict freight delivery or encourage off-peak delivery to eliminate double-parking obstructions.

Paris, France

Central One-Way Streets | Example 3: 31 m



Existing | 31 m | 50 km/h

Existing Conditions

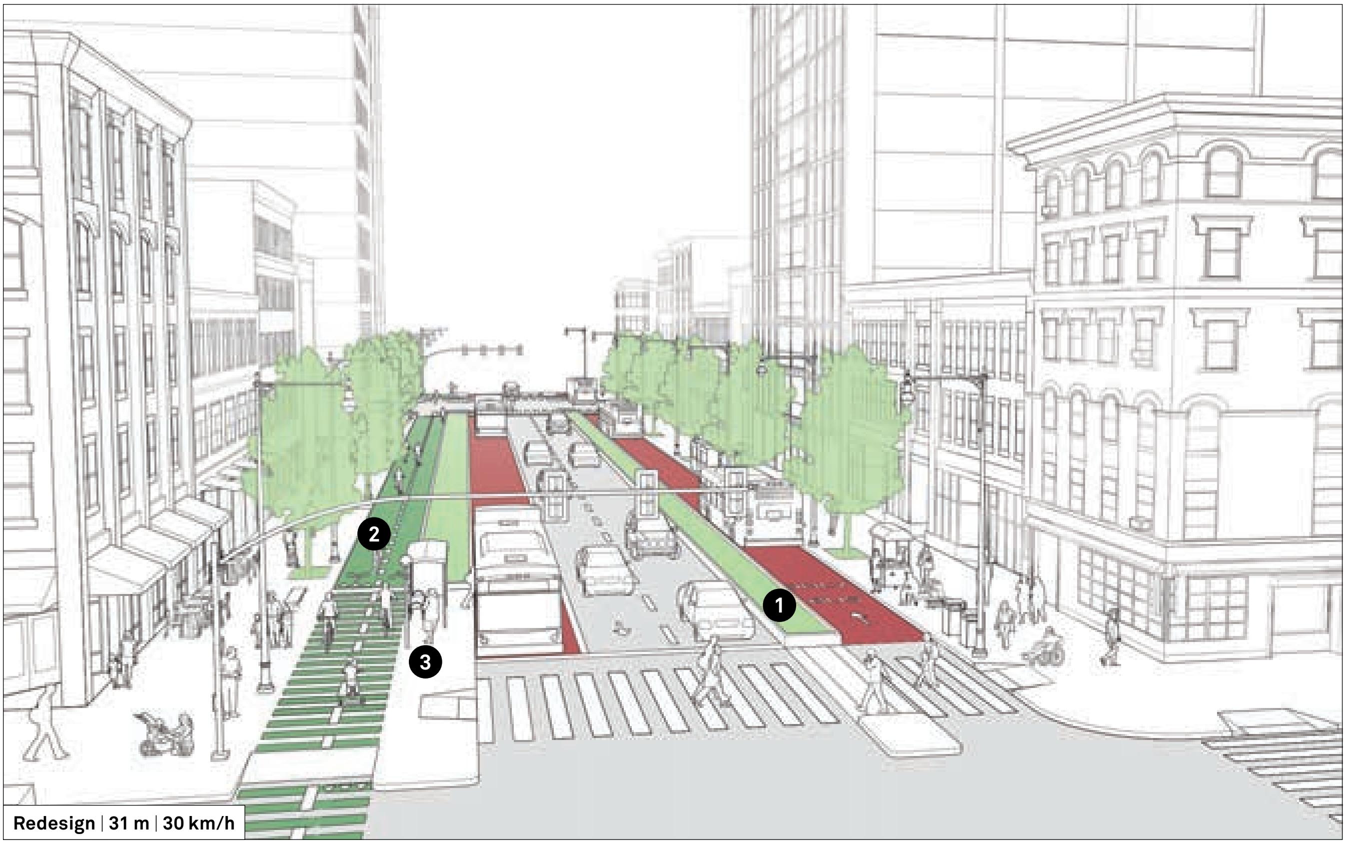
This illustration depicts a large one-way street in the center of the city that coexists with a highly active mix of land uses.

Large one-way streets might be designed for a 60-120 minute peak vehicular traffic period and remain well below capacity at other times of day. Single directional movement of traffic encourages speeding and results in unsafe conditions for all road users.

These streets may support existing transit in mixed traffic.

Nashville, USA

New Delhi, India



Redesign | 31 m | 30 km/h

Design Guidance

1 Convert the one-way, fast-moving street to a two-way street with dedicated transit lanes in both directions. Contraflow transit from adjacent streets can be relocated to operate in a dedicated lane, increasing transit legibility and simplifying routing. Corridor signal progression and turn prohibitions separate conflicting movements.

2 Add a bidirectional, protected cycle track to support cycling as a sustainable mobility option.

Where cycling infrastructure is present, locate transit stops away from the curb, on transit islands, with cyclists routed behind the stop. Locate curbside transit stops within the street furniture zone to avoid obstructions and maintain a clear path for pedestrians. *See 6.4.4: Cycle Facilities.*

Remove car parking at blocks with transit stops to prevent encroachment on bus lanes, reduce transit delays, and limit the need for enforcement.

3 The median also acts as a pedestrian refuge island, reducing the effective crossing distance and creating a friendlier pedestrian environment. *See 6.3.6: Pedestrian Refuges.*

The side median provides additional space for transit stops, cycle share stations, street furniture, and green infrastructure strategies.

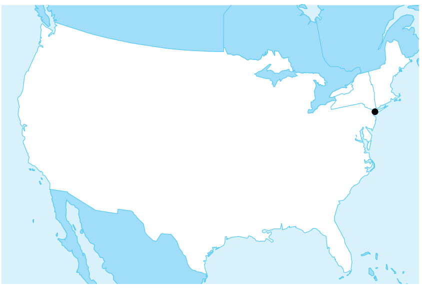
Install signals for cyclists where turns across the cycle track will create conflicts between cyclists and motorists. Align concurrent movements and separate conflicts to create safer intersections. *See 8.8: Signs and Signals.*

São Paulo, Brazil

Amsterdam, The Netherlands

CASE STUDY

Second Avenue; New York City, USA



Location: Manhattan, New York City, USA

Population: 8.4 million
Metro: 20 million

Right-of-way: 30 m

Context: Mixed-Use (Office/Commercial/Residential) Main Street

Funding: Public

Max. Speed: 40 km/h

Overview

Manhattan's Second Avenue was transformed through a series of projects, each reconfiguring a multi-block section of the street.

Changes were first as road markings, establishing new pedestrian refuge islands and curb extensions that were later constructed when capital funding became available. The parking lane was moved away from the curb to create a protected cycle track, part of a 48-km network installed throughout the city since 2007.

Bus-only lanes, bus bulbs, and off-board fare collection machines were introduced as part as the Select Bus Service project, a BRT-like service that has increased bus ridership and decreased travel times as part of a citywide effort.

Before

After

Photos: New York City Department of Transportation

Rather than increasing peak period traffic delay, this transformation helped reduce vehicle volumes as users shifted to other modes, including cycling and collective transit.

Goals

- Reduce the number of traffic crashes and provide a safe, dedicated cycle facility.
- Decrease bus travel times. Increase cycle volumes and pedestrian activity.
- Reduce traffic volumes, noise, and pollution while increasing pedestrian safety.
- Improve economic vitality and increase local business activity.

Lessons Learned

The project improved mobility and sustainability. It helped reduce vehicle volumes as users shifted to other modes, including cycles (+60%) and collective transit (+9% increase in bus ridership).

Protected cycle lanes and pedestrian refuge islands helped reduce traffic crashes with injures by 7% in the corridor.

Involvement

Public Agencies
New York City Department of Transportation, New York City Transit

Citizen Associations and Unions
Local advocate groups

Designers and Engineers
New York City Department of Transportation, New York City Department of Design and Construction

Evaluation

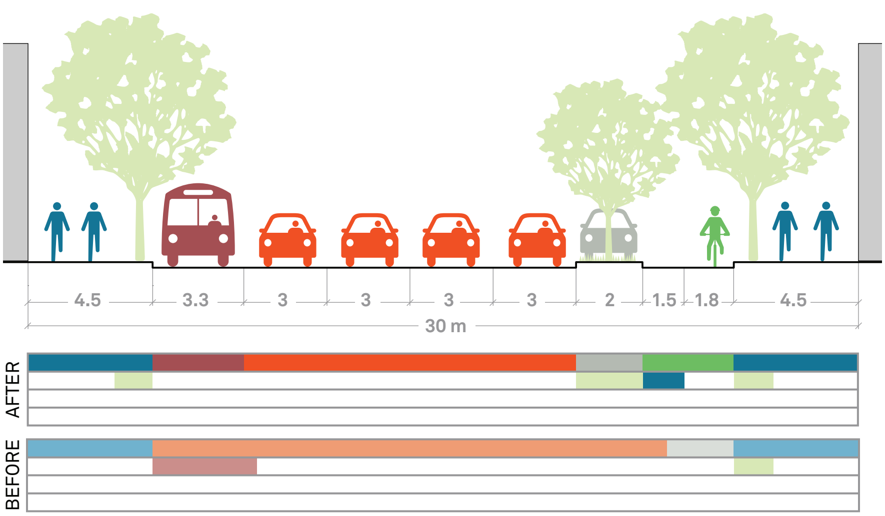
+60%
Increase in cycle volume

+9%
Increase in M15 bus ridership

-12%
Decrease in AM vehicle volume

-15%
Decrease in PM vehicle volume

-7%
Decrease in traffic crashes with injuries



Key Elements

Removal of one motor vehicle lane.

Lane narrowing.

Crossing distance shortened from 18 m to 12 m by introducing pedestrian refuge islands.

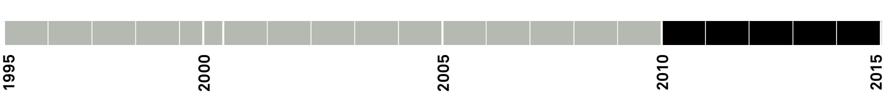
Parking-protected dedicated cycle track, 1.8 m wide.

1.5 m cycle buffer between the parked cars and the cycle lane.

Upgraded bus-only lane with red pavement and automated enforcement.

Project Timeline

2010–Today



Users Legend:

- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape

10.6.2 | Central Two-Way Streets | Example 1: 20 m

Existing | 20 m | 50 km/h

Central two-way streets present an opportunity for transformation that increases the street's capacity to serve multiple users. Narrowing travel lanes, allocating space for cycling and collective transport, and upgrading the pedestrian environment improve the street's performance. Incorporating public space and green infrastructure enhancements such as street trees, permeable paving, and parklets, can further invite vibrancy.

Existing Conditions

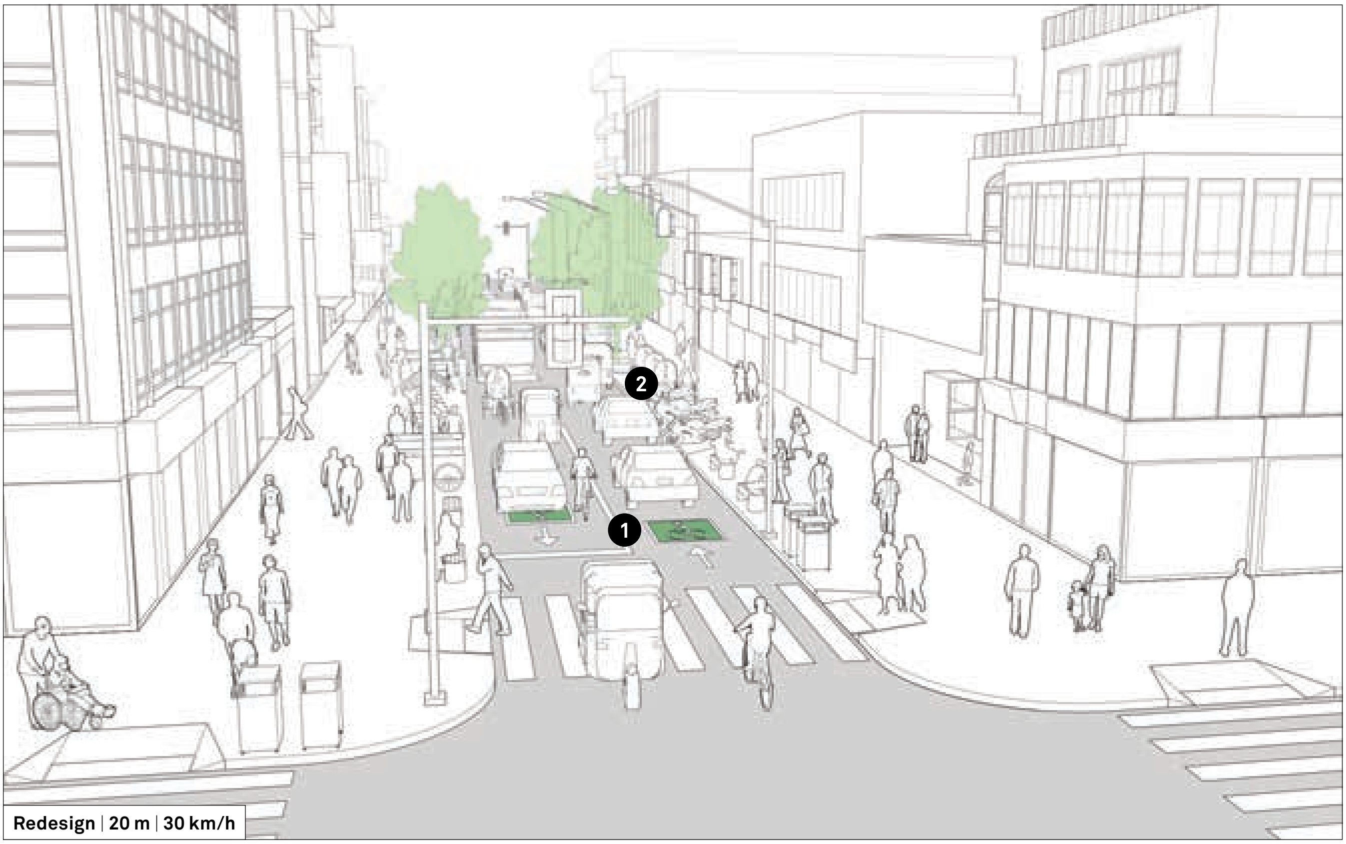
The illustration above depicts a one-way street that was not originally designed for motorized traffic. This street type might have moderate traffic volumes, and its high-pedestrian activity might spill onto the roadbed.

Pedestrians are subject to extreme danger due to motor vehicle speeding, and inaccessible, narrow, and discontinuous sidewalks that are often obstructed by utilities or parked cars.

Minimal road markings lead pedestrians to cross the street in undefined and unsafe zones.

Unregulated angled curbside parking and street vendors encroach upon pedestrian space and travel lanes.

Cairo, Egypt



Design Guidance

1 Convert the one-way street into a two-way street with one travel lane in each direction. Bidirectional travel reduces vehicular speeding as drivers must be cautious and aware of the oncoming traffic. *See 6.6.4: Travel Lanes.*

Two-way streets increase overall network connectivity but intersections must be carefully designed to minimize conflicts. Mitigate turn conflicts using tight corner radii, leading pedestrian intervals, and turn prohibitions for motor vehicles.

Replace angled parking with regulated curbside parking to provide increased space for sidewalks.

Widen sidewalks to accommodate trees, utilities, and commercial activity while ensuring a clear pedestrian path.

Install curb extensions to shorten pedestrian crossing distances and improve sightlines; lengthening the curb extension creates new public space for curbside amenities and street vendors. *See 6.3.7: Sidewalk Extensions.*

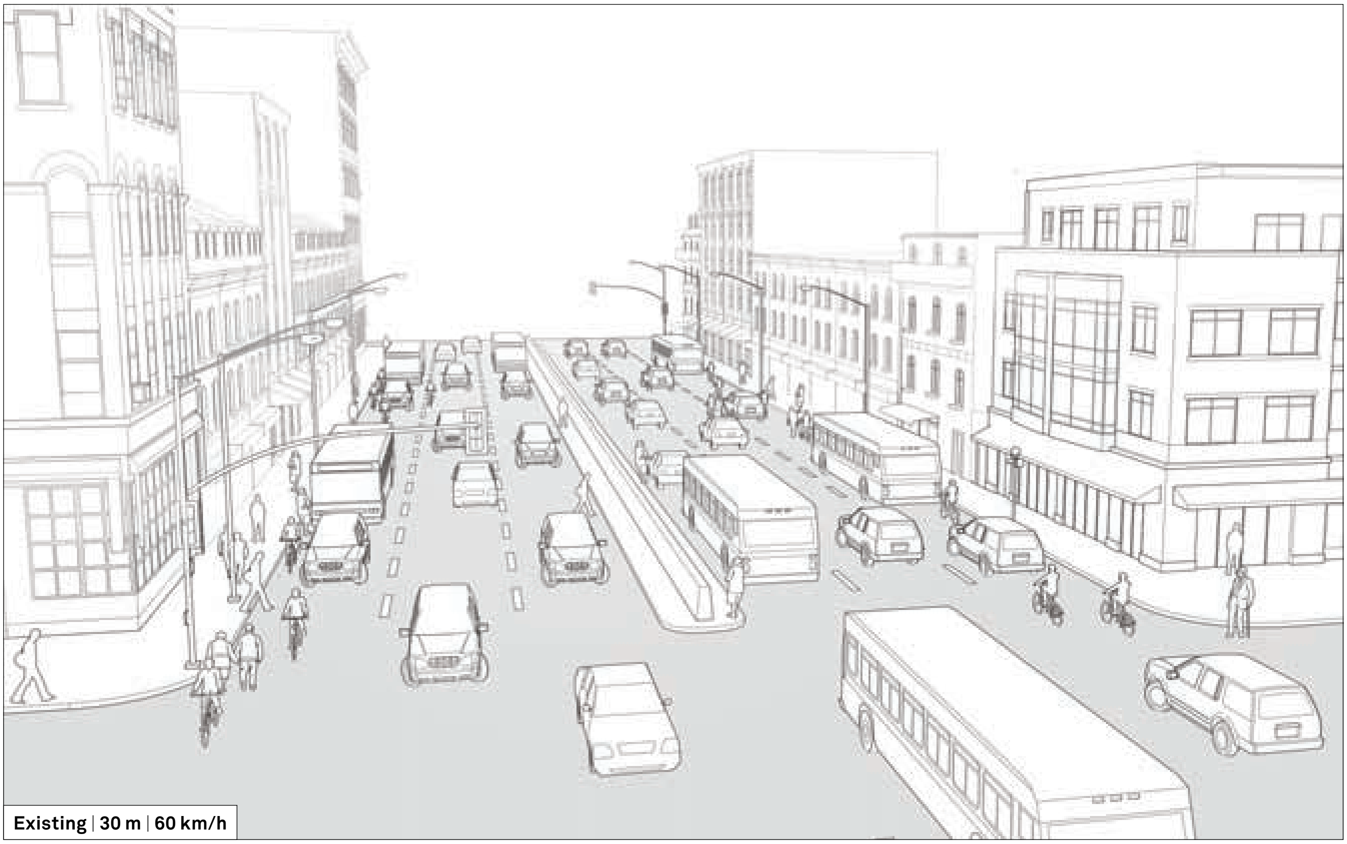
2 Use curbside parking lanes that are flexible zones to accommodate boarding for small collective transit and taxis, dedicated cycle or motorcycle parking, and tree pits.

Create a safer people-centered environment with sidewalk-aligned crosswalks, visible and legible markings, and added public amenities.

Improved pedestrian zones and drop-off areas are beneficial to local business establishments.

New York City, USA

Central Two-Way Streets | Example 2: 30 m



Existing Conditions

This illustration depicts a central city street which has been widened over time to accommodate motorized traffic at the expense of pedestrian space.

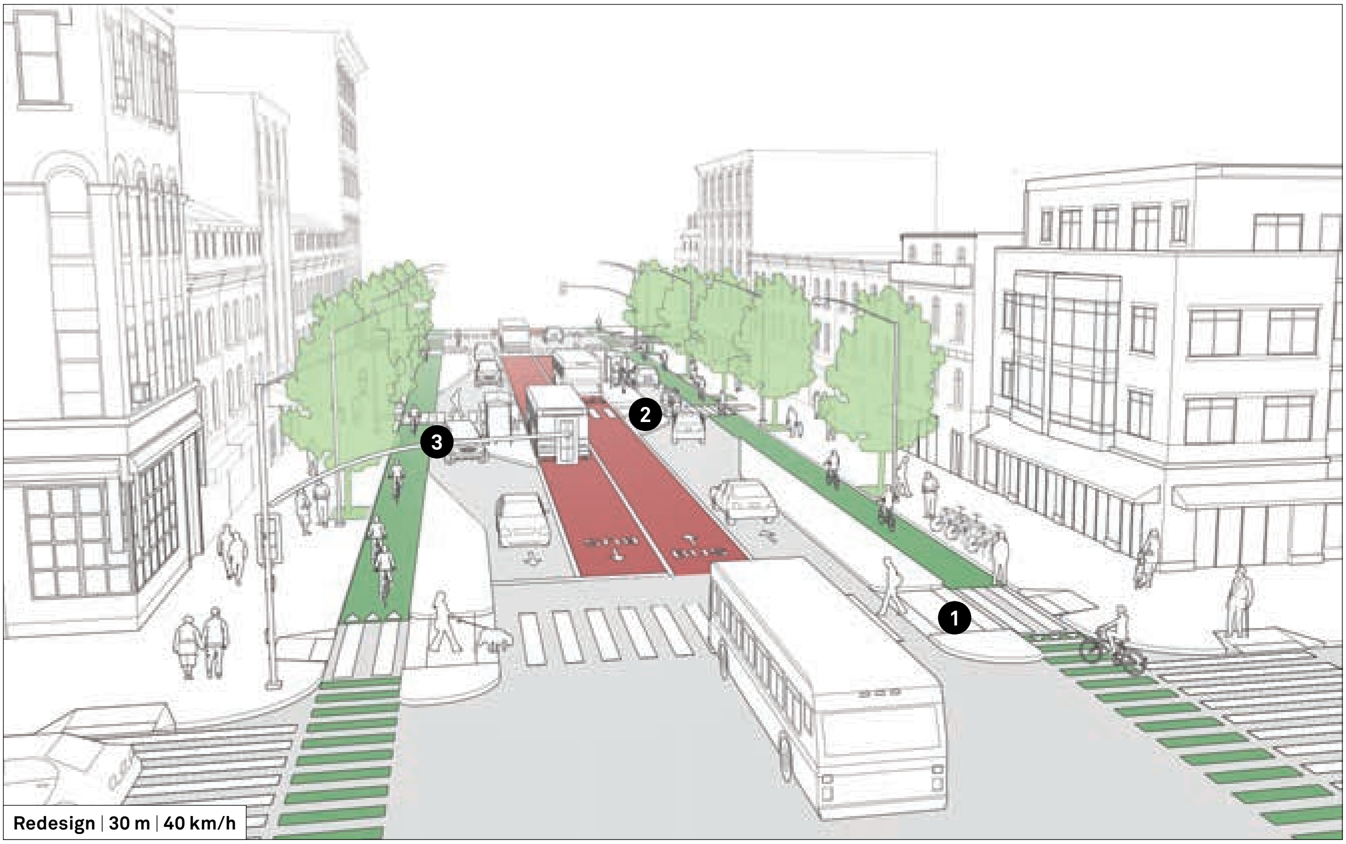
Wide travel lanes facilitate speeding and hinder pedestrian safety and comfort. Cross-street traffic is not signalized, creating frequent and serious conflicts among motorists and pedestrians.

Narrow and inaccessible sidewalks result in unsafe walking conditions, which can lead to a decline in business activities.

Central medians are equipped with barriers to restrict pedestrian crossing. This configuration often results in unsafe actions by the pedestrians, like jumping over or cutting through the barrier in order to cross the street.

Long crosswalk distances with no clear markings, lack of refuge islands, and high vehicular speeds expose vulnerable users to extremely unsafe conditions. Such streets act as pedestrian barriers and divide neighborhoods.

Bogota, Colombia



Design Guidance

Due to its central location, the street has the potential to transform the surrounding neighborhoods. Redesign this street to serve needs of all street users and increase its overall capacity.

Remove two travel lanes in each direction and provide accessible and wider sidewalks to support safe pedestrian movement and commercial activity.

1 Provide refuge islands, mark pedestrian crossings, and improve markings to make crossings safer and shorter.

Introduce a dedicated transit lane in each direction to increase transit capacity and efficiency.

2 Offset boarding islands provide for safe and efficient boarding and alighting for transit riders while reducing vehicle speeds at the bus stops.

3 Add a mid-block crossing to facilitate the access to the boarding islands on each side of the center-running transit-only corridor and shorten the crossing distance by providing safe refuge islands for pedestrians.

Offset the travel lane in correspondence to the boarding island to reduce speeds and improve motorists' yielding behavior.

Implement cycle tracks on each direction and planted buffers to provide safe facilities for cyclists.

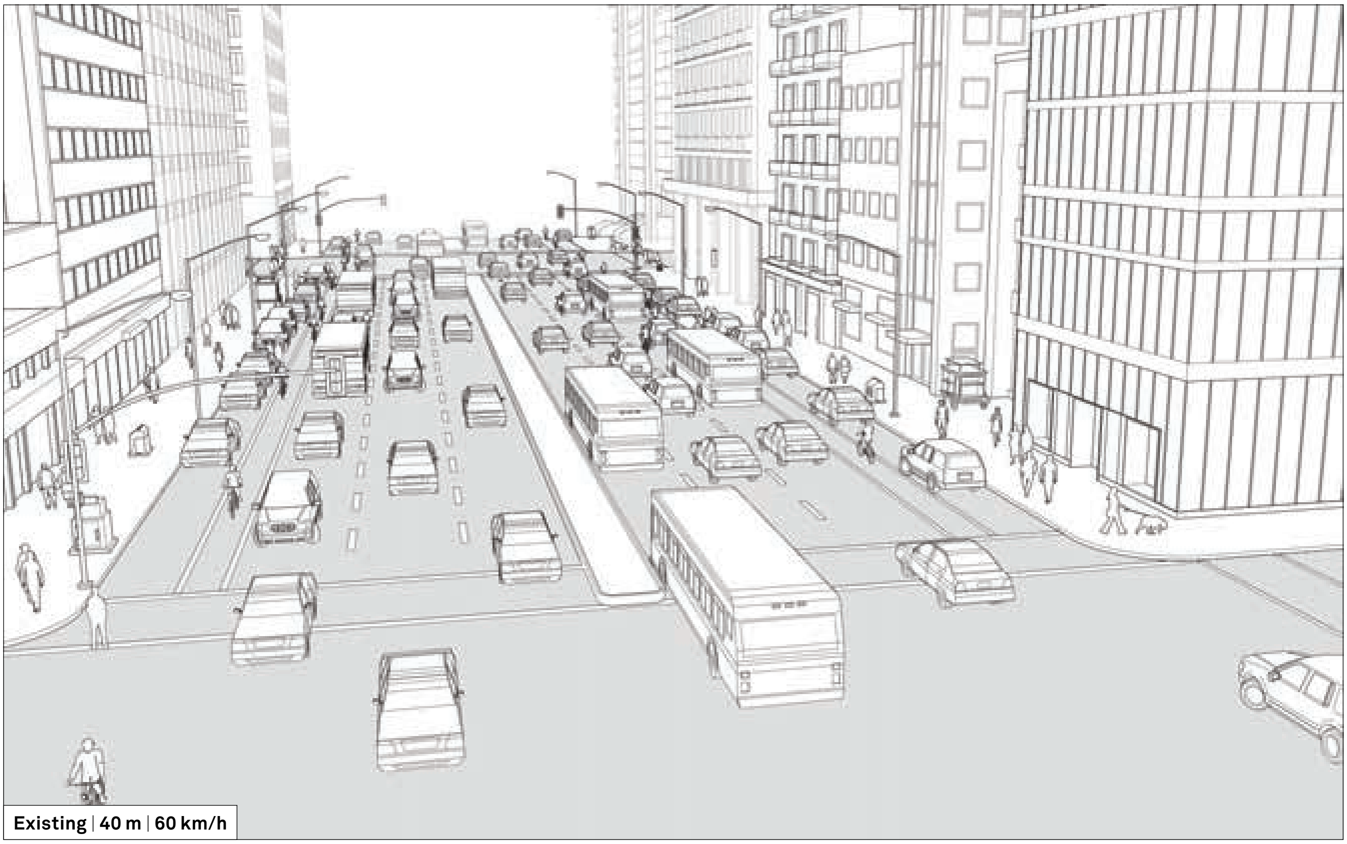
Add trees and green infrastructure on the sidewalks and the medians to provide shade, reduce noise, improve air quality, and support stormwater management. *See 7.2: Green Infrastructure.*

Making the street more aesthetically appealing and comfortable for pedestrian use can attract businesses and help to regenerate the district.

Mexico City, Mexico

Toronto, Canada

Central Two-Way Streets | Example 3: 40 m



Existing Conditions

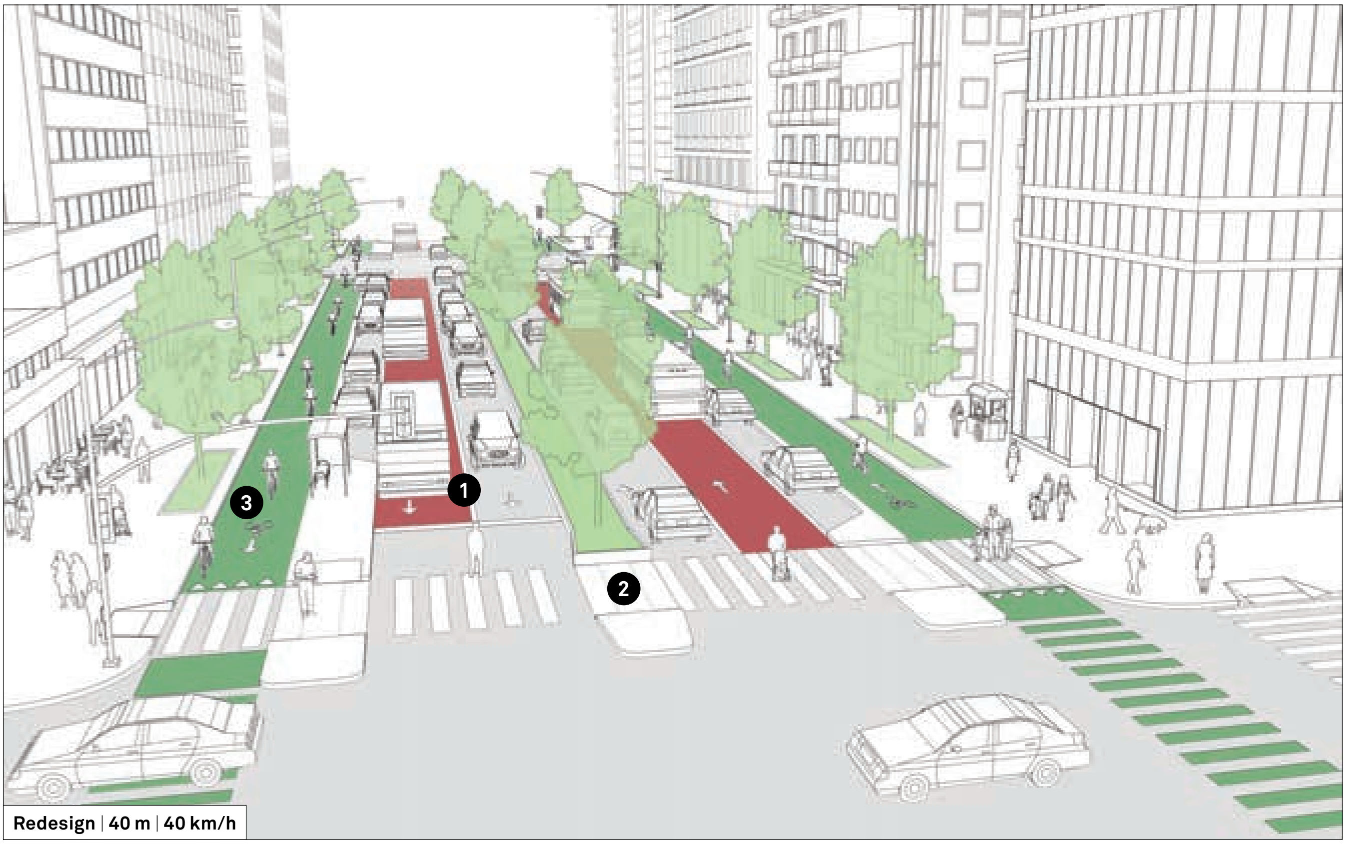
The illustration above depicts a large two-way street in the center of the city, used both as a thoroughfare and as a destination with a mix of programs. Wide travel lanes encourage speeding and create an unsafe walking and cycling environment.

Cross-traffic turns are a frequent source of conflict, resulting in head-on collisions between motorists and pedestrians or cyclists.

Cyclists feel unsafe riding on narrow cycle lanes located between fast-moving traffic and the curbside parking car door zone. Double-parked vehicles and cars getting into the parking lane may force cyclists to suddenly divert into the adjacent travel lane at great risk.

Wide medians act as an undefined refuge island, creating a pause point in the middle of the street with no protection. Heavy turn volumes and large corner radii at the intersections result in high-speed turns that put pedestrians and cyclists in danger.

Singapore, Singapore



Redesign | 40 m | 40 km/h

Design Guidance

1 Redesign large streets to accommodate both through- and destination-oriented traffic. Give priority to movement of high occupancy vehicles, like mass transit, van-pools, and taxis, to increase the street's capacity.

Add dedicated transit lanes and enable in-lane transit stops using bulbs or islands. *See 6.5.5: Transit Stops.*

If transit frequency is low, consider allowing taxis and other means of collective transport in these lanes to increase the movement capacity.

2 Widen the central median at the intersection and at transit stops to create refuge islands. Refuge islands, when paired with curb extensions at parking spaces, help in reducing time and crossing distances for pedestrians.

Widen sidewalks to provide universal access, add green infrastructure, and increase space for pedestrians and commercial activity.

3 Reduce travel lanes and add parking-protected cycle tracks in each direction.

Side-running directional cycle tracks allow easy and convenient access for cyclists. *See 6.4.4: Cycle Facilities.*

Restrict freight delivery or encourage off-peak delivery to eliminate double-parking obstructions. *See 9.4: Design Hour.*

Support new configurations and traffic patterns through education campaigns and proactive enforcement. Allow users time to adjust to significant transformations.

Add landscaping to provide shade and greenery, with potential to supplement stormwater management. These additions may also help attract new businesses.

Seattle, USA

Götgatan; Stockholm, Sweden

CASE STUDY

Location: Södermalm, Stockholm

Population: 0.9 million
Metro: 1.4 million

Length: 0.8 km

Right-of-Way: 28 m

Context: Mixed-Use (Commercial/Residential/Office)

Cost: 3.1 million SEK (360,000 USD)

Funding: City of Stockholm, traffic committee

Max. Speed: 30 km/h

Overview

Götgatan is a lively main street in the inner-city Södermalm district, with offices, shops, and restaurants serving a dense residential district. The street is also the most important route for cyclists coming to the Central Business District from the southern suburbs.

The street space has been reallocated on a trial basis to provide better opportunities for city life and improved access for cyclists and pedestrians.

Götgatan is a part of the wider Urban Mobility Strategy adopted by the city to increase use of transit, walking, and cycling, and improve the urban environment.

Before

After

Photos: City of Stockholm

A full-time community liaison officer shared information with local retailers and relevant stakeholders, addressing challenges as they emerged throughout the construction period.

Goals

- Improve the urban environment and performance of a popular street for shopping and entertainment.
- Improve accessibility and safety for cyclists, which outnumber motorists at the peak hours.
- Illustrate the principles of the Urban Mobility Strategy and demonstrate the flexibility of the street environment as part of a wider public engagement process.
- Collect information on a broad range of metrics to inform decision making for a more permanent reconfiguration of the street.

Lessons Learned

A trial is a successful method to achieve change quickly when unsure of the results.

Make clear that the process is a trial so that users do not think the changes are being done cheaply.

Activate areas of temporary furnishing to make new uses clear. Deliveries are a key point of conflict and need careful consultation and design.

Involvement

Public Agencies
City of Stockholm traffic administration, Stockholm Police, the Greater Stockholm Fire Brigade, Stockholm Transport

Associations and Groups
Stockholm Chamber of Commerce, Swedish Association of Road Transport Companies, Swedish Taxi Association, Swedish Cyclists' Association, Swedish Pedestrians' Association, local residents, and traders

Evaluation

+90%

Increase in cycle volume

68%

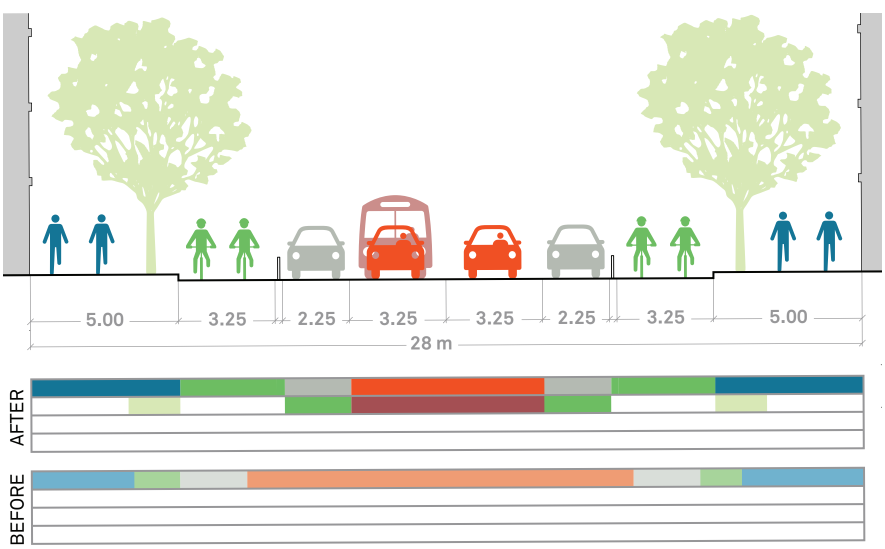
Pedestrians declared that the street environment is better than before

72%

Cyclists felt safer after the implementation

40%

Business owners think the street environment is better



Key Elements

Increased sidewalk widths with zones for temporary street furnishing.

Wider cycle lanes in the former parking lane.

Cycle parking facilities for 50 cycles in former vehicle parking spaces.

Green wave for cyclist set at 18 km/h, visualization through countdown signs.

Reduction from two motor vehicle lanes in each direction to one in each direction.

Reduction in speed limit from 50 km/h to 30 km/h.

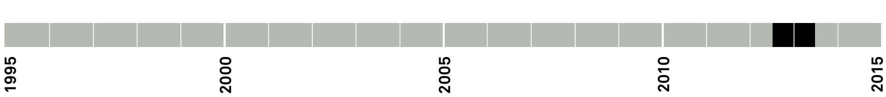
Measures to improve deliveries.

Increased parking charges to ensure turnover.

Users Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape

Project Timeline

June 2013–June 2014 (9 Months)



10.6.3 | Transit Streets | Example 1: 16 m

Existing | 16 m | 50 km/h

Transit Streets, often running along commercial corridors, prioritize the street for pedestrians and transit. Motorists are prohibited beyond limited deliveries and occasional permitted access. In some cases, transit such as buses, light rail, or streetcars have dedicated spaces between sidewalks. Other times, an even surface is designed for pedestrians, allowing transit to move slowly through the shared space.

Existing Conditions

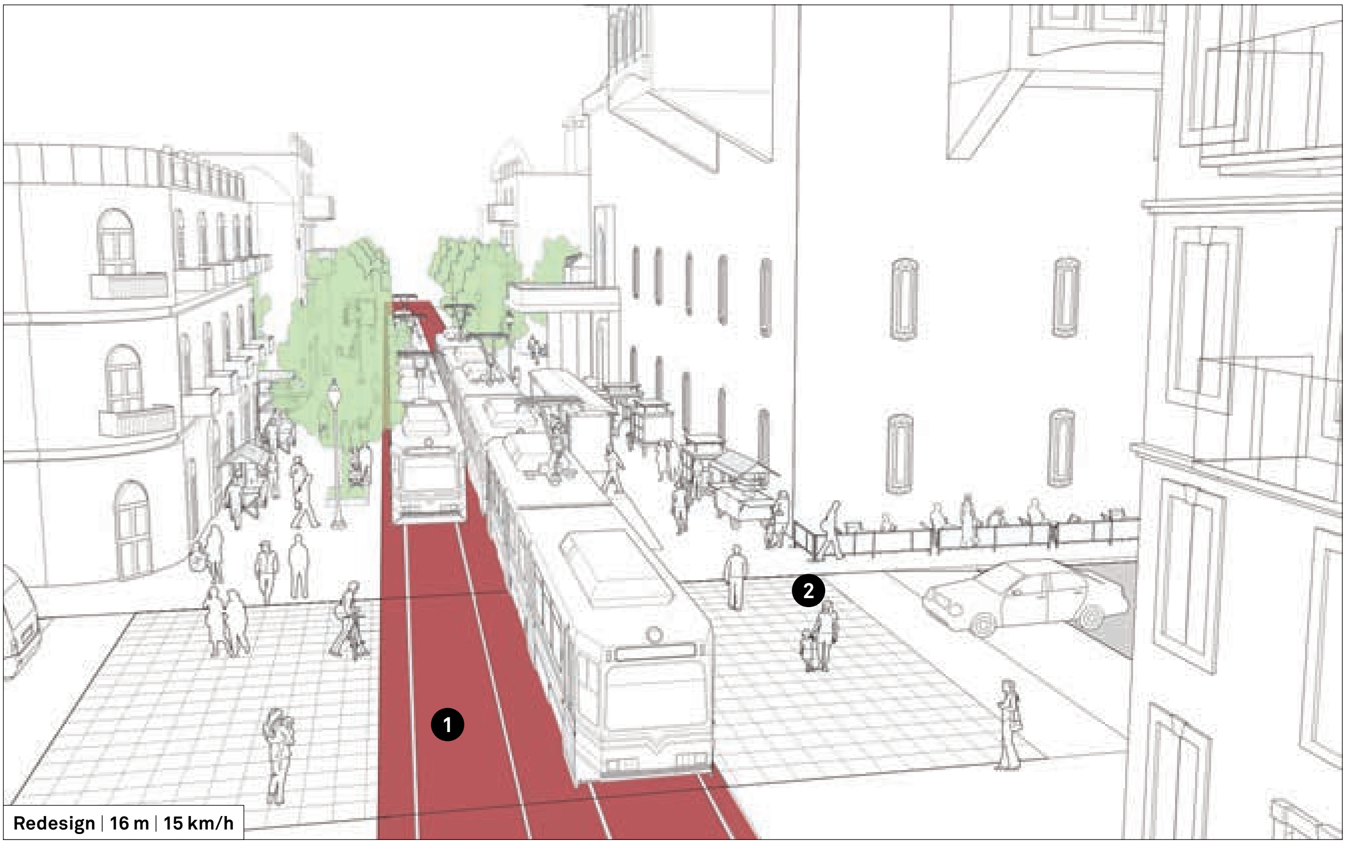
The condition illustrated above may be found in old parts of cities that were not designed for vehicle use but have evolved over time to accommodate motorized traffic.

These streets might bustle with commercial activity and pedestrians, but users are subject to unsafe conditions due to a combination of crowded sidewalks, traffic congestion, and missing crosswalk markings.

Travel lanes accommodate mixed vehicular traffic and collective transport, and are often congested.

This street has narrow sidewalks that are insufficient to allow commercial activity and heavy pedestrian volume to coexist without conflicts.

Mumbai, India



Design Guidance

When street space is restricted, transit and pedestrians are prioritized. When more space is available, additional pedestrian-priority space and wider sidewalks are encouraged, allowing a range of activities, landscaping, and street furniture.

1 Restrict all vehicular access. Add accessible and grade-level, center-running mass transit to give the street a shared quality and to ensure pedestrian priority.

Treat the street as a shared zone to expand the pedestrian realm and increase permeability across the street.

Add side-boarding transit stops at wider sections of the street. Construct accessible platforms that enable fast and easy transit boarding. *See 6.5.5: Transit Stops.*

2 Raise intersections to the transit grade where the transit street intersects with cross streets for continuous pedestrian access. Provide a change in pavement markings, pattern, or color to indicate areas where vehicles cross the street.

Add trees and native landscaping where width allows. Street furniture and vendors may be encouraged where possible but a clear path for pedestrians must be maintained.

Loading and deliveries must be permitted only during off-peak hours. *See 8.5: Volume and Access Management.*

Zurich, Switzerland

Transit Streets | Example 2: 32 m

Existing | 32 m | 50 km/h

Existing Conditions

The street illustrated above plays an important role in the city's network, connecting commercial hubs to neighborhoods with a center-running transit spine. At times, transit is physically separated to increase efficiency.

This two-way street has two travel lanes in each direction with medium traffic volumes and high pedestrian activity.

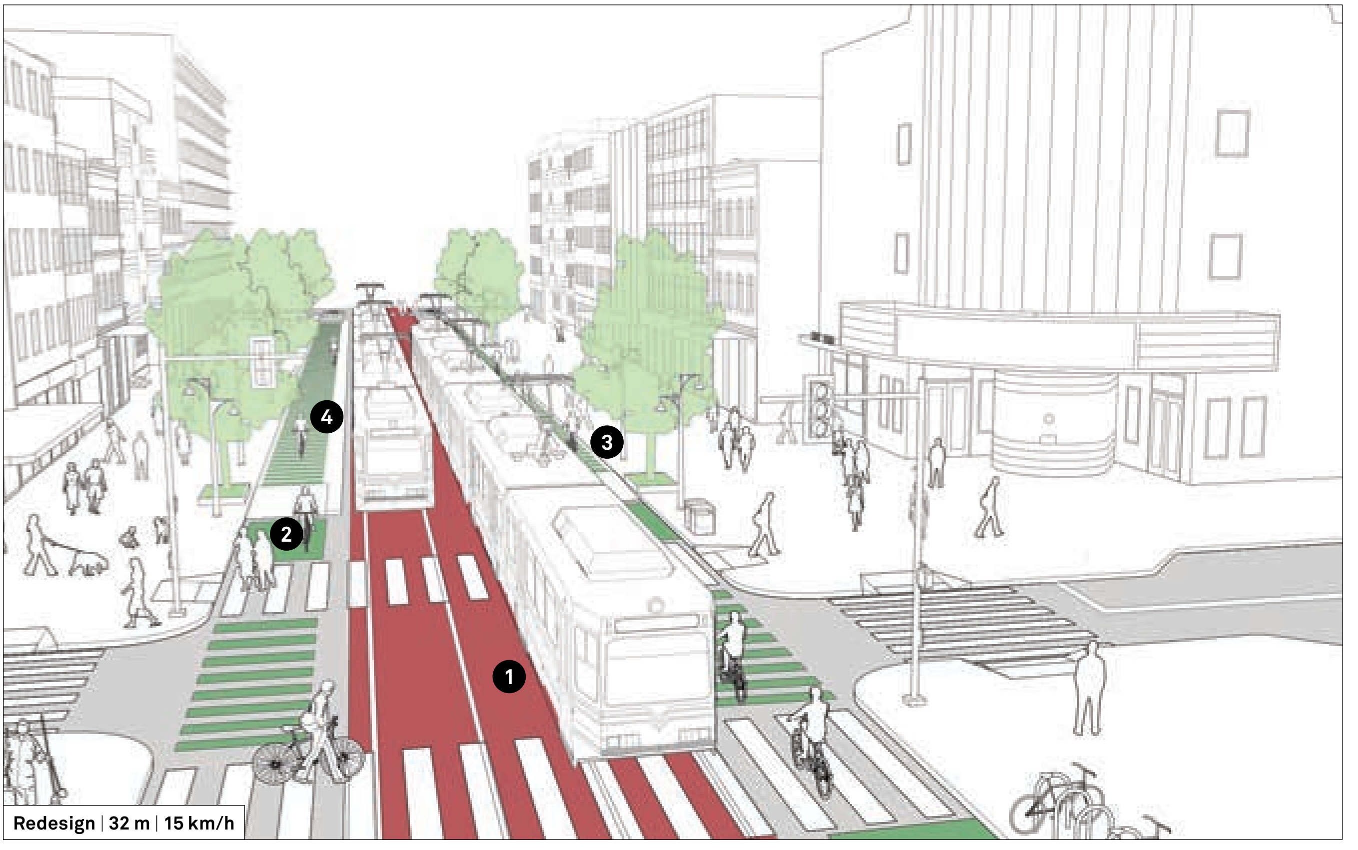
Pedestrian access across the street is allowed at designated, but limited, points where crossings are not universally accessible.

Pedestrians spill onto the roadbed due to limited space for commercial and pedestrian activity.

Transit riders face difficulty in crossing multiple travel lanes to get from the transit stop on the central median to the sidewalk.

Frequent curb cuts result in multiple turning and weaving conflicts, rendering the street unsafe for cyclists.

Kolkata, India



Design Guidance

Reconfigure this street to re-establish it as an important commercial corridor. Restrict or filter through-traffic and separate transit, cycle, and pedestrian zones within the right-of-way. Prioritize stopping-and-staying activities.

1 Improve center-running mass transit by raising the roadbed at the transit stops to increase boarding efficiency and accessibility. *See 6.5.4: Transit Facilities.*

Vehicle traffic may be fully prohibited, restricted to certain times of day, or required to turn off after one or two blocks to manage volume and preserve pedestrian and transit priority.

Provide dedicated space within the curb zone to accommodate trees, street furniture, vendors, cycle racks, and other elements.

2 Add dedicated cycle lanes on both sides of the street. Separate cyclists at transit stops and provide two-stage turns at intersections to ensure cyclists do not cross in-street rails except at near 90-degree angles. *See 6.4.4: Cycle Facilities.*

Provide a minimum buffer of **0.5 m** from transit in each direction to avoid conflicts between cyclists and passengers boarding the transit.

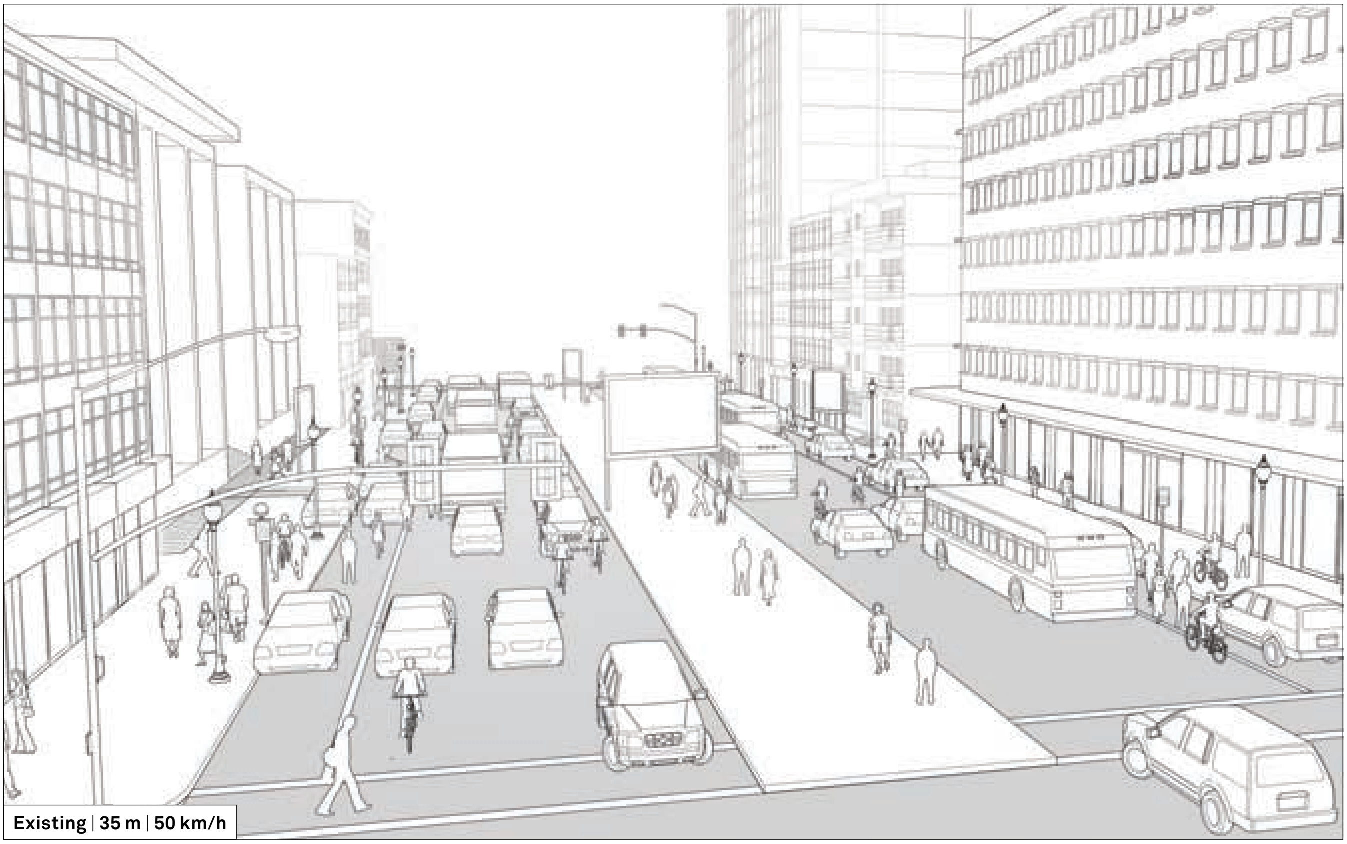
3 Place transit stop amenities behind the cycle lanes to offer shelter for passengers while maintaining a continuous clear path for cyclists. *See 6.4.4: Cycle Facilities.*

4 Where cycle lanes encounter transit stops, ramp lanes up to sidewalk level to allow accessible transit boarding. Provide distinct markings on cycle lanes at transit stops to indicate crossing paths with transit passengers.

Restrict loading and deliveries to off-peak hours.

Budapest, Hungary

Transit Streets | Example 3: 35 m



Existing | 35 m | 50 km/h

Existing Conditions

The illustration above depicts a wide two-way street that connects central business districts, downtown areas, institutional centers, and residential neighborhoods. Long, continuous corridors become increasingly congested as they approach central areas, progressively collecting regional commuters.

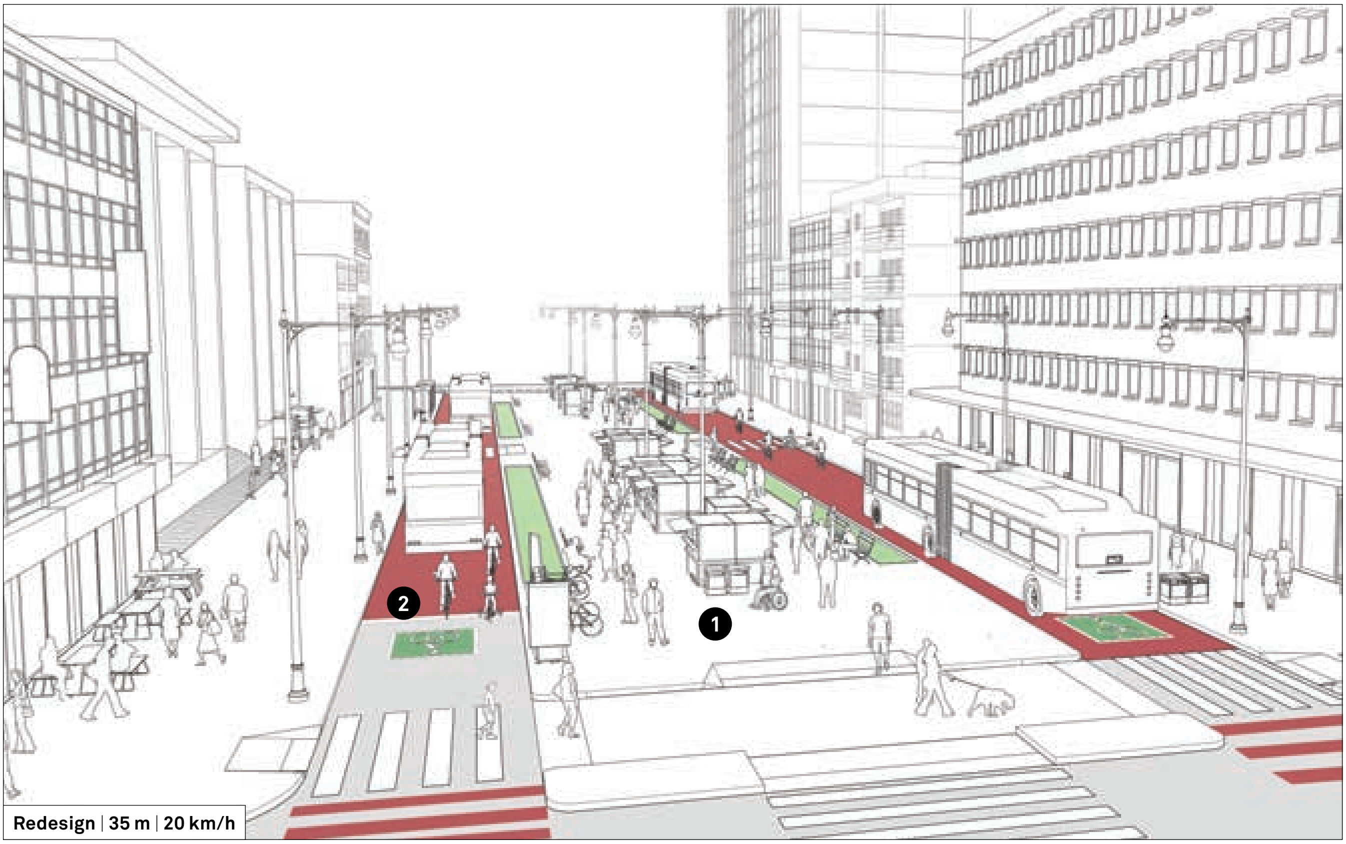
This street supports local and through-traffic along with major bus routes. Private motor vehicles, taxis, and informal collective transport all demand curbside space, resulting in frequent double-parking, blocked transit stops, and unsafe cycling conditions, as well as delayed transit service.

Billboards and signage on sidewalks reduce visibility at intersections.

Narrow sidewalks inhibit commercial activity and cause conflict with transit stops and heavy pedestrian use.

Long crosswalks increase pedestrian crossing time, and raised medians with no ramps render the crossings inaccessible.

Accra, Ghana



Design Guidance

1 Redesign the street to provide a widened central median that serves as a public space with trees, benches, lighting, street vendors, cycle share, water fountains, and public amenities.

Remove private vehicle access to prioritize pedestrians, transit, and cyclists. Frequent, reliable transit service can serve far more users than private vehicles, with significantly improved safety and comfort for pedestrians and cyclists.

2 Dedicate lanes for transit with low speeds, shared with cyclists and taxis. Provide transit shelters on the widened central median or the sidewalk furniture zone depending on transit vehicle door alignment. Maintain the pedestrian clear path when locating transit shelters and stops.

Widen sidewalks to provide universal accessibility and increase space for pedestrians and commercial activity.

Allow for loading and deliveries only during off-peak hours.

Add green infrastructure along the central median and the sidewalks to support stormwater management and create a more appealing environment. *See 7.2: Green Infrastructure.*

Barcelona, Spain

Minneapolis, USA

Swanston Street; Melbourne, Australia

Location: Downtown CBD, City of Melbourne, Australia

Population: 4.4 million

Length: 1200 m–10 blocks

Right-of-Way: 30 m

Context: Mixed-Use (Office/Commercial/Residential) Main Street

Cost: 25.6 million AUD (18.8 million USD) for design and construction of phases 1 and 2

Funding: Public

Max. Speed: 10 km/h

Overview

Swanston Street is one of the main north-south streets in the city of Melbourne, lined on either side with a number of iconic landmarks.

Once a very congested and polluted street, it is today an example of pedestrian-oriented and transit-priority street design.

Before

After

Photos: Top - City of Melbourne and Bottom -Dongsei Kim

Goals

- Strengthen the identity of the city and enhance user experience and access for shoppers, visitors, workers, cyclists, and transit users.
- Create more attractive, democratic, and safe public spaces.
- Provide spaces where people can gather and meet.
- Provide spaces for art and events.

Key Successes

Providing an improved retail environment.

Providing an efficient, equitable, and comfortable public transport experience.

High-quality streetscape design, which reflects the unique characteristics of the city.

Newly constructed tram stops brought in a shared zone, changing cyclist, commuter, and pedestrian behavior.

In an innovative outreach strategy, comedians were engaged to work with users to understand the new spatial arrangement and the changed traffic conditions.

Key Elements

Increased sidewalk width.

Improved legibility of the street.

Dedicated cycle lanes.

Raised tram platforms to allow universal access.

Removal of taxi and vehicle access at all times.

Service, delivery, and emergency vehicle access maintained.

High-quality finishes, including bluestone and granite paving, custom designed lighting, furniture, and signature planting.

Transit stops located along public destinations where possible, such as City Square and the State Library.

Lessons Learned

Community engagement throughout the project ensured information sharing and engagement with the community throughout design development. A full-time community liaison officer kept local retailers and relevant stakeholders informed and dealt with issues as they emerged throughout the construction period.

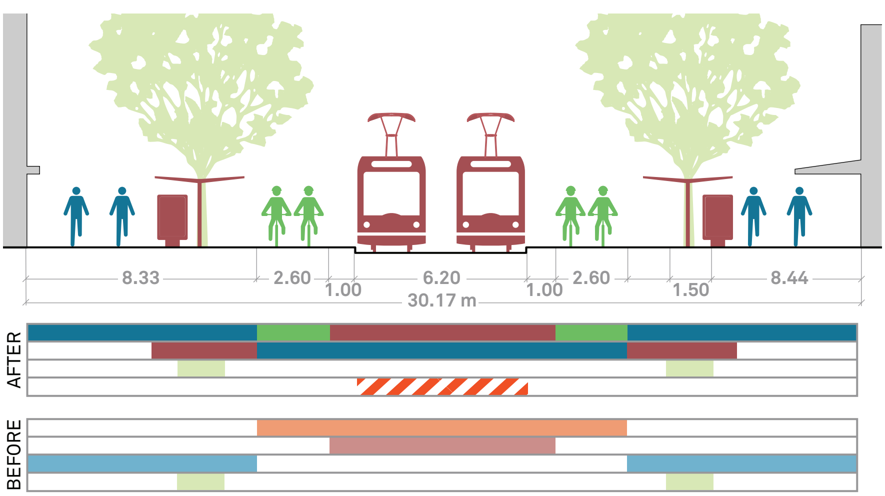
Involvement

Public Agencies
City of Melbourne, Yarra Trams, VicRoads, Victoria Police, Department of Transport, Planning and Local Infrastructure

Private Group and Partnerships
Australian Industry Group, Australian Retail Association

Citizen Associations and Unions
Bicycle Victoria, Transport Workers Union

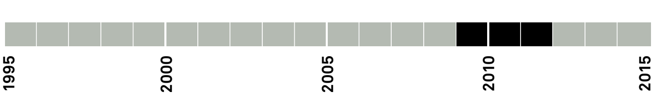
Designers and Engineers
City of Melbourne



Users Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Shared

Project Timeline (Phase 1 and 2)

June 2009–June 2012 (3 Years)

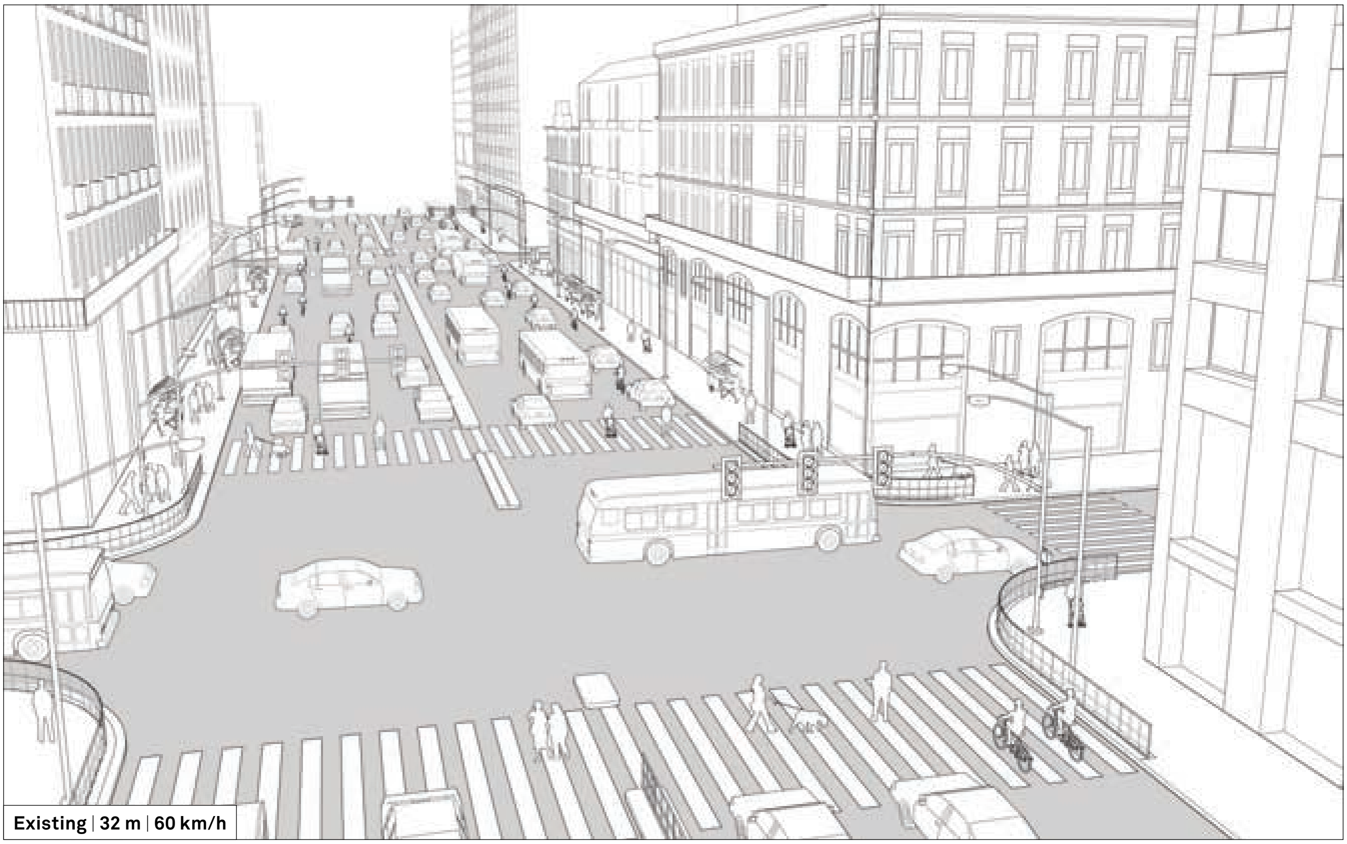


Evaluation

+24%
Increase in pedestrian volumes (2010–2018)

+5%
Increase in retail space (2010–2018)

10.6.4 | Large Streets with Transit | Example 1: 32 m



Large streets with transit help connect neighborhoods to one another. They allow access to key destinations and city services using collective transport such as bus, BRT, light rail, or streetcar. While these streets primarily provide mobility, their design must accommodate all users. As heavy transit corridors, they also support a high volume of pedestrians.

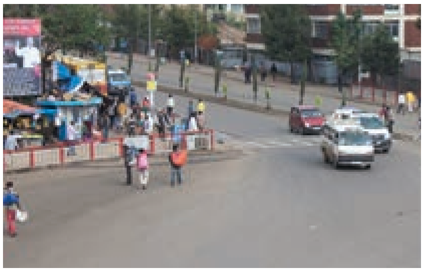
Existing Conditions

The two-way street condition shown in the illustration above prioritizes through movement. Three wide travel lanes in each direction accommodate mixed traffic and encourage speeds that are inappropriate for urban conditions. Transit routes suffer frequent delays caused by traffic congestion and slow curbside boarding.

Narrow and fenced sidewalks impede pedestrians from crossing the street along natural or desired paths, reinforcing a hostile walking environment. High volumes of pedestrian activity are funneled into a tight space.

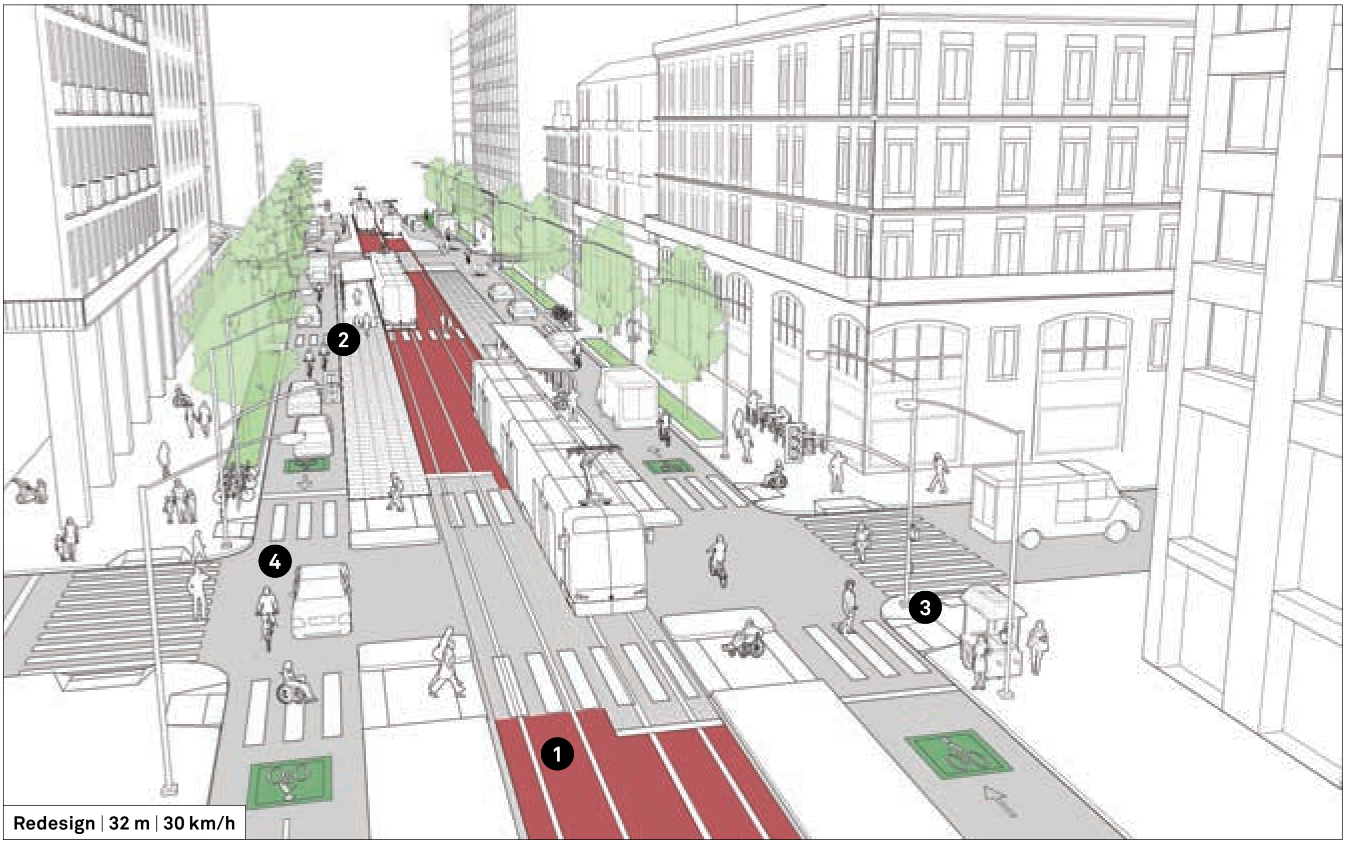
Crosswalks are recessed from the intersections, increasing walking time and distances for pedestrians. Long crosswalk distances and inadequate refuge islands create unsafe conditions.

Cyclists ride on sidewalks where they conflict with pedestrians, or in mixed traffic, where they are forced to negotiate congestion and fast-moving vehicle traffic.


Addis Ababa, Ethiopia


Nairobi, Kenya

Heavy rains overload below-grade stormwater drainage, causing frequent flooding and ponding, especially at curb ramps and pedestrian access points.



Redesign | **32 m** | **30 km/h**

Design Guidance

This street provides an opportunity for increased capacity and improved public space through the introduction of mass transit, management of travel lanes, and additional pedestrian facilities.

1 Introduce a center-running light rail service to increase the total capacity and improve transit access at a regional scale.

Design transit stops to allow level boarding for universal accessibility.

2 Add mid-block crossings near the transit stops to reduce walking distances, with appropriate traffic controls. Provide transit shelters to create a comfortable waiting space, protected from the weather.

Widen sidewalks to improve accessibility and increase space for pedestrian and commercial activity. *See 6.3.4: Sidewalks.*

3 Eliminate fences and ensure frequent pedestrian crossings. Align crossings with sidewalks for a direct and continuous clear path.

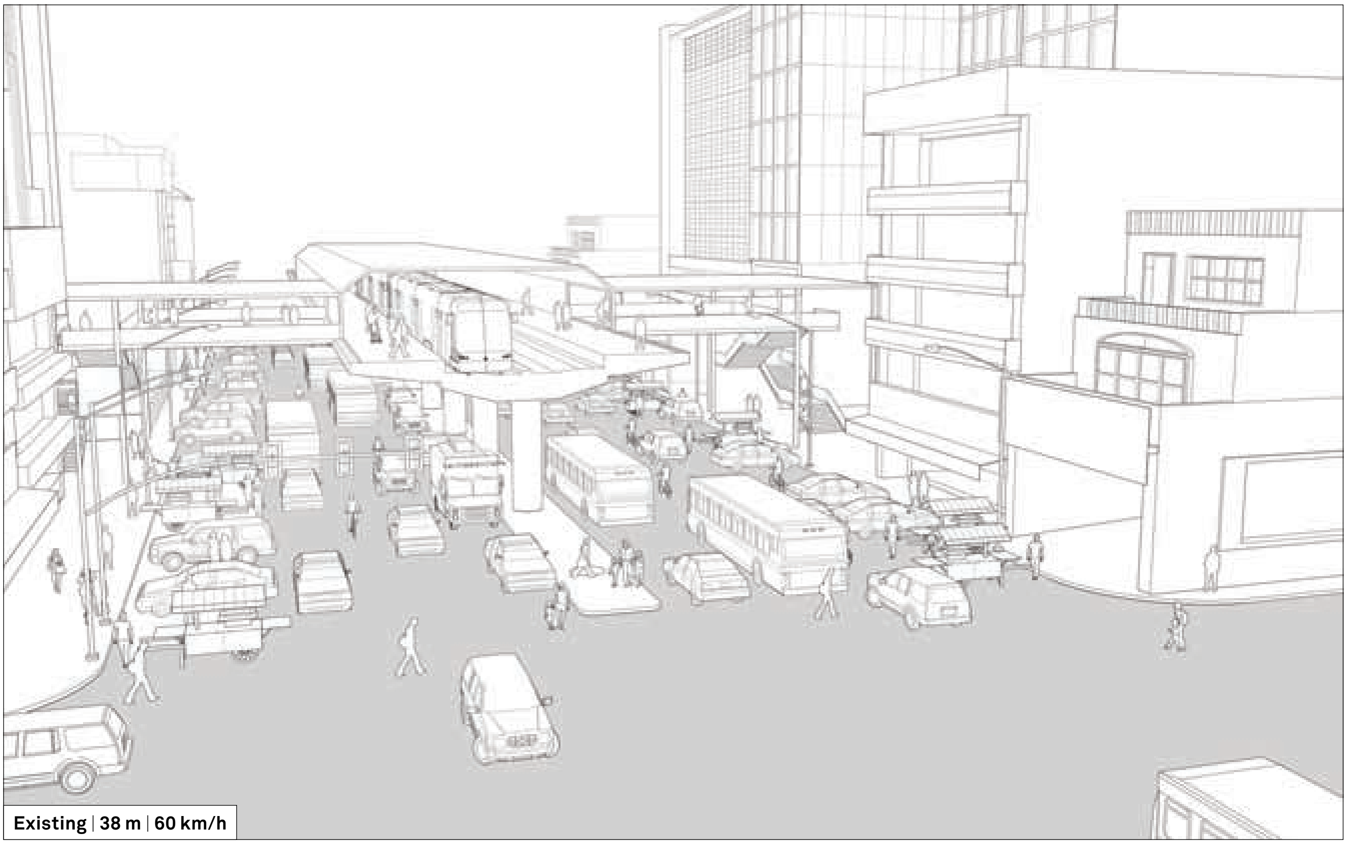
4 Maintain one travel lane in each direction to be shared by cyclists and motorists. Provide parking spaces and loading bays on blocks with no transit stops.

Turns across oncoming traffic are a common cause of conflict and should be carefully managed. Turns across the transit lane create conflicts and slow transit operations. Left turns should either be prohibited or managed in separate turn lanes with protected signal phases. Especially in dense street grids, turns may be rerouted to non-station blocks or through the grid. *See 8.8: Signs and Signals.*

Warsaw, Poland

Add green infrastructure such as bioswales, rain gardens, and connected tree pits and trenches to better manage stormwater runoff and recharge the water table. Permeable surfaces like pavers and pervious concrete can be applied on lightly used surfaces—such as pedestrian spaces—to supplement stormwater management, so long as materials are kept clean of debris and blockages.

Large Streets with Transit | Example 2: 38 m



Existing | 38 m | 60 km/h

Existing Conditions

This street depicted in the illustration above has elevated transit infrastructure. It provides regional connectivity and a variety of collective transit options. The elevated transit stop serves as a multimodal exchange point, but at-grade collective transport has poor reliability due to shared travel lanes and heavy congestion.

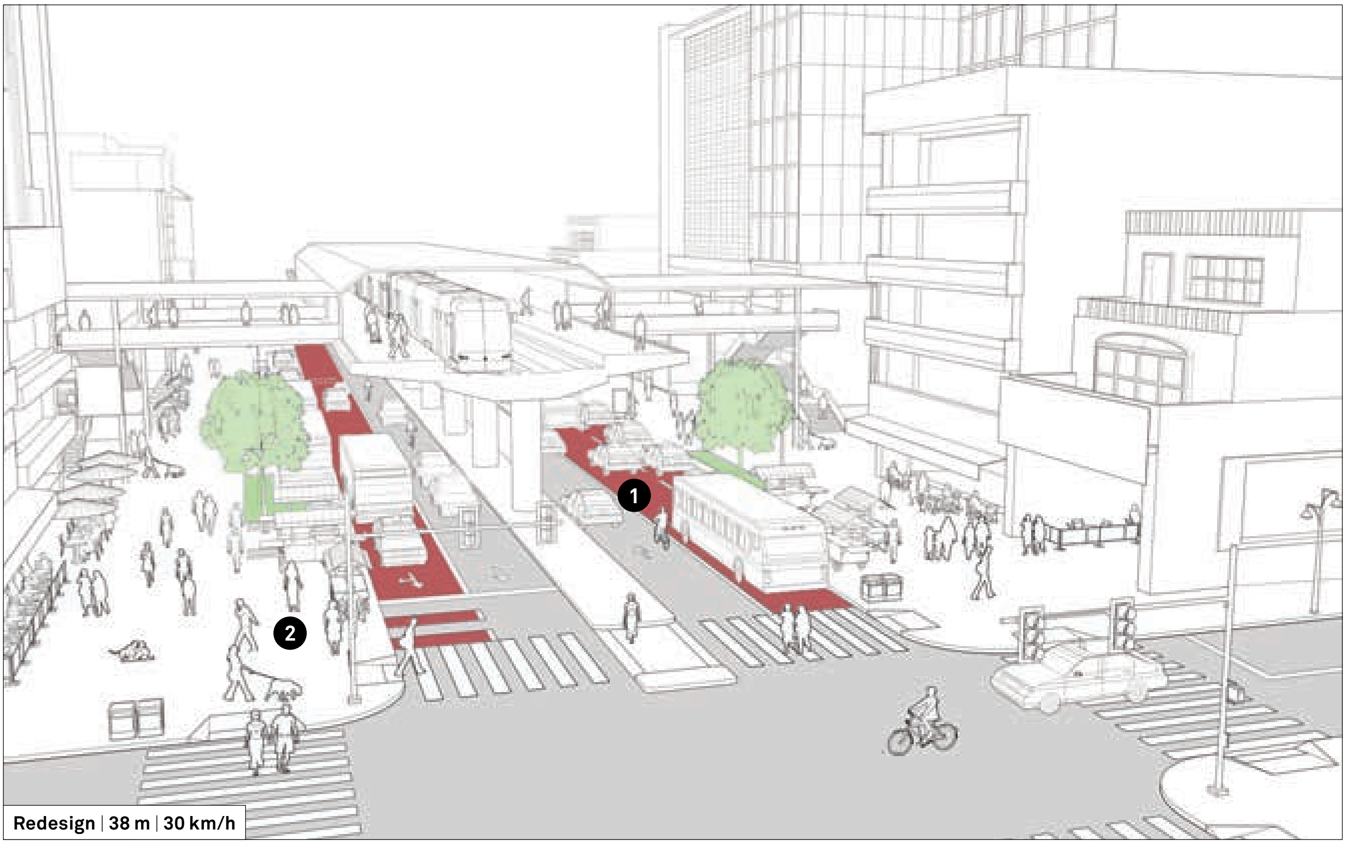
Collective transport passengers are faced with poorly marked stops and disorienting transfer spaces.

Undefined areas along the sidewalks are occupied by street vendors, rickshaws, and unregulated car and motorcycle parking that force pedestrians onto the roadbed.

High speeds, long crossing distances without clear markings, and narrow, non-continuous, and inaccessible sidewalks create an unsafe pedestrian environment.

Utilities and elevated transit infrastructure often block clear pedestrian paths and limit visibility.

Paris, France



Design Guidance

The street is redesigned to prioritize transit and shared mobility, improve walking conditions and public space, and transform key transfer nodes into recognizable landmarks.

1 Eliminate excess traffic lanes and designate a curbside transit lane in each direction. Marked transit lanes may be shared with taxis and small collective transport. To ensure smooth operation of collective transport services, provide pull-in and drop-off stops for boarding, which allows other transit vehicles to pass. These alternate with accessible parking spaces and taxi stands. *See 6.5.4: Transit Facilities.*

Widen sidewalks and provide universal accessibility to better serve the needs of heavy pedestrian volumes.

2 Extend the curb to create dedicated areas for vendors in the same zone as pull-in lanes, ensuring a clear path for pedestrians.

Extend the central median to create pedestrian refuge islands. *See 6.3.6: Pedestrian Refuges.*

Provide signage and wayfinding for transit stops to help navigate the users and to identify transit routes.

Add street furniture and trees to provide a comfortable street environment. *See 6.3.3: Pedestrian Toolbox.*

Chengdu, China

Boulevard de Magenta; Paris, France

Location: 9th and 10th arrondissements, Paris, France

Population: 2.2 million
Metro: 12.1 million

Length: 1.95 km

Right-of-Way: 30 m

Context: Mixed-Use (Commercial/ Residential/Office)

Cost: 24 million EUR (27 million USD)

Funding: Municipality of Paris, Region Ile-de-France, Central Government

Max. Speed: 50 km/h

Key Elements

Sidewalk widened (from 4 m to 8 m) and lane narrowed.

Crossing distance shortened from 20 m to 12.8 m

Separated cycle track

Dedicated bus-only lane

New trees planted along the sidewalk extension

Before

After

Photos: APUR, NACTO

Overview

The transformation of the boulevard is part of the Espaces Civilisés, a program started in the early 2000s. The program was launched to reduce the high traffic that dominated many of the wider boulevards and avenues of Paris.

The Boulevard de Magenta was one of the first to be transformed following the introduction of the civic space guidelines.

Nicknamed by local residents the Magenta Expressway, it had endured traffic volumes of up to 1,400 vehicles per hour in each direction, frequent speeding, and many fatalities at intersections. Noise and pollution levels were among the highest in the city.

Under the program, €24 million were invested in widening sidewalks, planting trees, and building protected cycle tracks. Granite dividers were installed to protect a new dedicated bus lane.

To accommodate deliveries, 30-minute truck parking spaces were located on the curbside of the dedicated bus lane.

No curbside parking was provided along the boulevard. Intersections were made safer with secured crosswalks, widened pedestrian refuge islands, and extended crossing phases.

New pavement, landscaping, and street furniture were added to sidewalks and plazas. Businesses signed charters of quality to establish uniform signage and public stewardship practices.

Goals

- Reduce traffic fatalities, congestion, and pollution.
- Create a more attractive and pedestrian-oriented environment.
- Create a space that supports businesses.

Involvement

Municipality of Paris, Region Ile-de-France, Central Government, citizen associations, and business owners.

Evaluation

+145%

Increase in cycle volume between 2001 and 2007

-50%

Decrease in traffic volume

-32%

Decrease in air pollution between 2002 and 2006

0

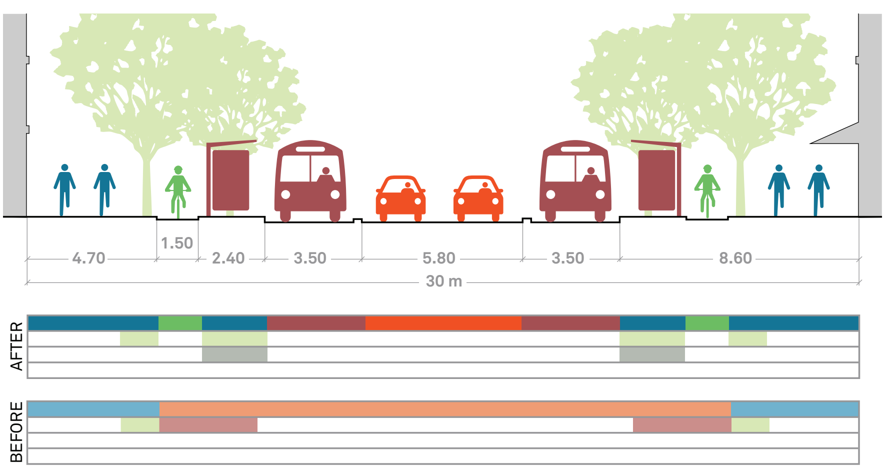
Traffic fatalities in four years after the transformation

-5.5%

Decrease in noise pollution (from 72 dB to 68 dB)

293

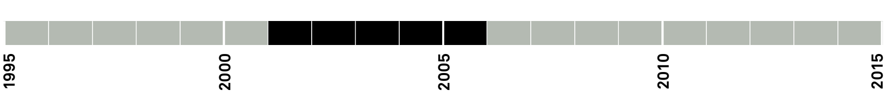
Number of trees planted



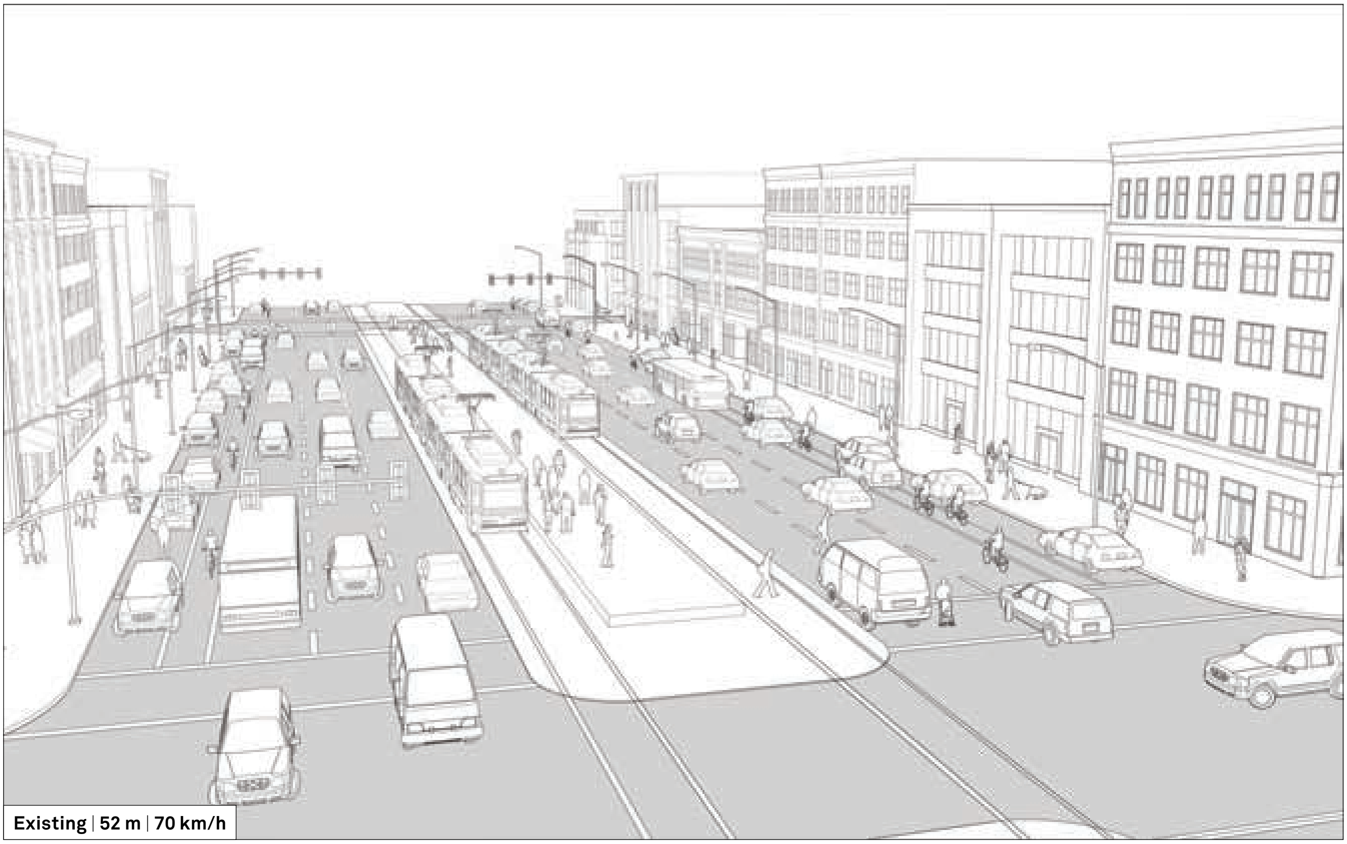
Users Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Delivery Parking

Project Timeline

March 2001–May 2006 [Approx. 5 Years, 3 Months]



10.6.5 | Grand Streets | Example 1: 52 m



Existing | 52 m | 70 km/h

The widest city streets are often regionally significant but not locally integrated. Dangerously fast, yet prone to congestion, these streets serve through-traffic at the expense of other uses and form barriers to pedestrians and cross-street traffic. Many streets were designed based on an assumption that greater width was the only way to expand capacity for moving people. However, wider streets are inherently less efficient per lane, so the best way to increase efficiency is to use higher occupancy modes.

Existing Conditions

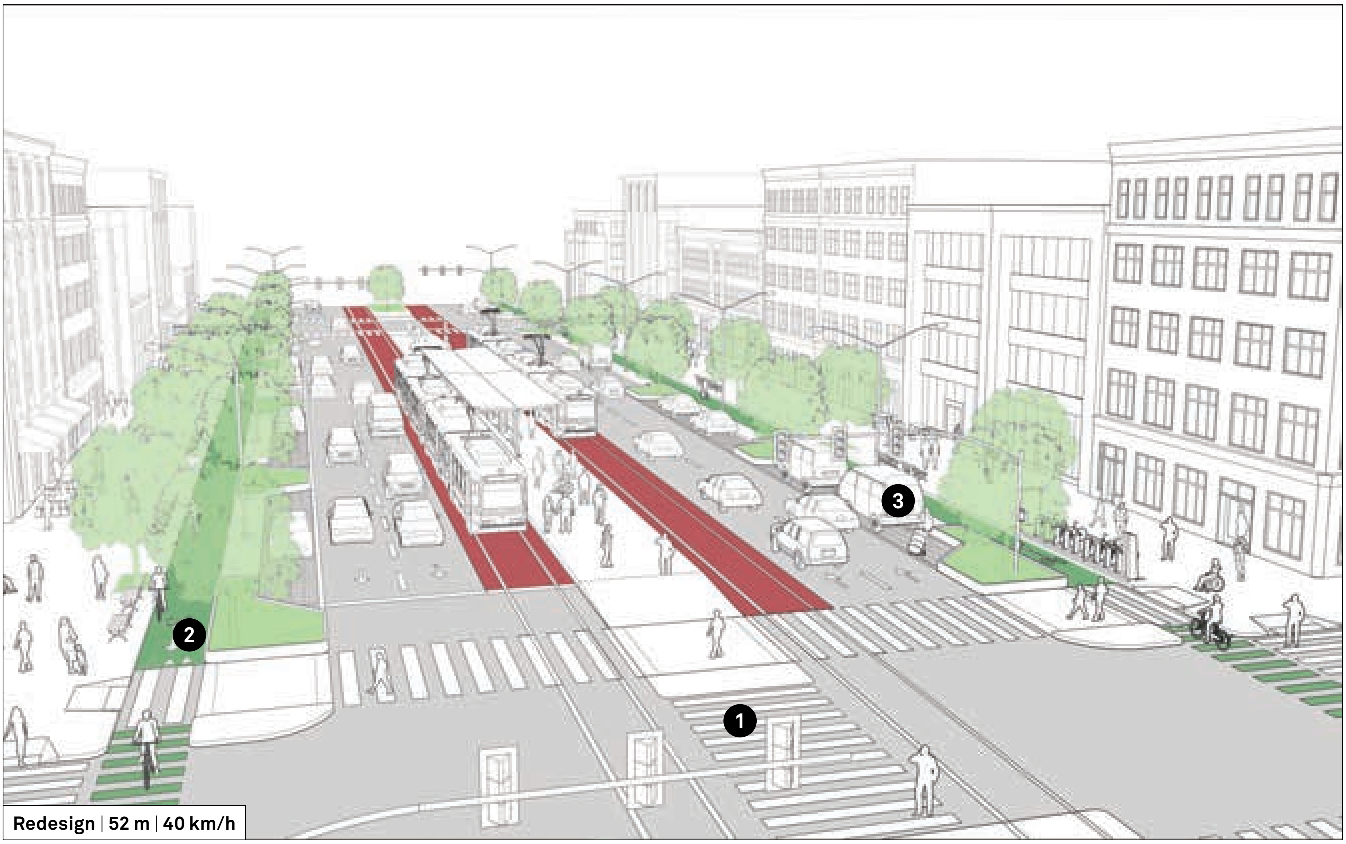
The illustration above depicts a major street with center-running transit and unprotected cycle lanes. It serves as an arterial corridor with three wide lanes for fast-moving traffic in each direction. This street connects the city across multiple neighborhoods and regionally.

Safety issues for vulnerable users are increased by long crosswalk distances and poorly defined and recessed crosswalks that increase crossing time.

Sidewalks are wide. However, a lack of landscaping and ground-level activities render them uninviting and dull spaces.

Center-running and center-loading mass transit has restricted entry and exit points. Stops might lack proper accessibility features.

Double-parked freight vehicles create weaving conflicts and safety hazards at peak hours for motorists and cyclists.



Design Guidance

Delineate and demarcate different modes to efficiently share and manage the street.

Enhance the centre-running transit lanes through distinct paving or color treatments. Provide level boarding platforms, accessible ramps and paths, as well as audible and tactile features.

1 Add controlled mid-block crossings at transit stops to facilitate safe crossing from both sides of the street. Cover transit stops to provide a sheltered and comfortable waiting space.

Install refuge islands on the central median and curb extensions to shorten the overall crossing distance.

Encourage commercial activity and street vendors on wide sidewalks. Add street furniture and landscaping while maintaining a continuous pedestrian clear path.

Antwerp, Belgium

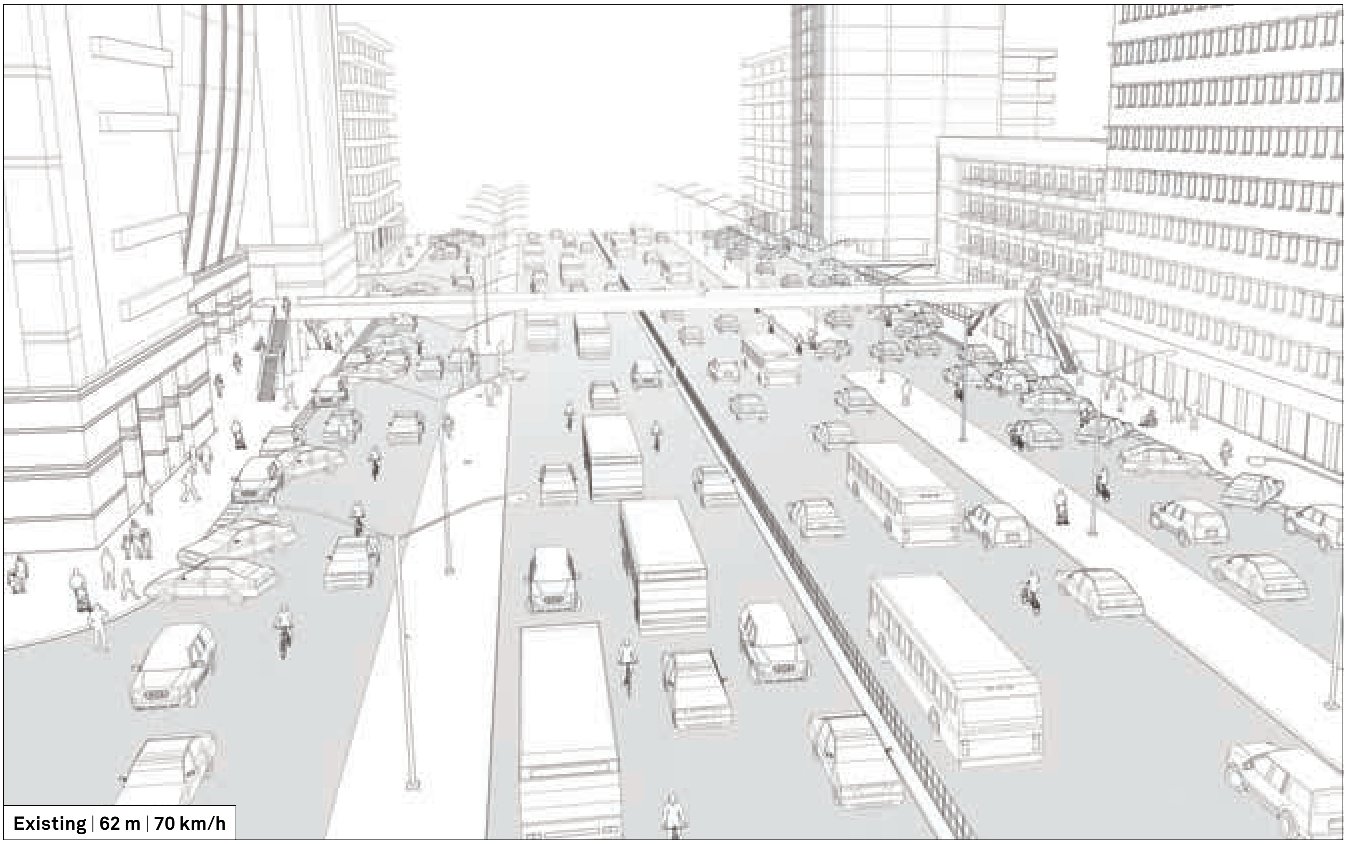
2 Replace one travel lane in each direction with a parking-protected cycle track to encourage cycling as a healthy and sustainable mobility choice. Cycle share stations may be sited adjacent to cycle tracks and near transit stations to accommodate first- and last-mile trips.

Install street trees and green infrastructure along parking-side medians to dissipate road noise, manage stormwater run-off, and improve the urban environment.

Barcelona, Spain

3 Provide loading zones at strategic locations within the parking strip. Restrict freight delivery or encourage off-peak delivery to eliminate double-parking obstructions. *See 6.7: Designing for Freight and Service Operators.*

Grand Streets | Example 2: 62 m



Existing | **62 m** | **70 km/h**

Existing Conditions

The large city street illustrated above carries fast-moving through-traffic in the central travel lanes and local traffic mixed with double parking in the side-running service lanes. A fenced median limits pedestrian cross-street access.

Collective transport operates in mixed traffic in the center through-lanes. Congestion reduces transit service quality and reliability. Transit riders wait on the side medians with no shelter or protection.

Ho Chi Minh City, Vietnam

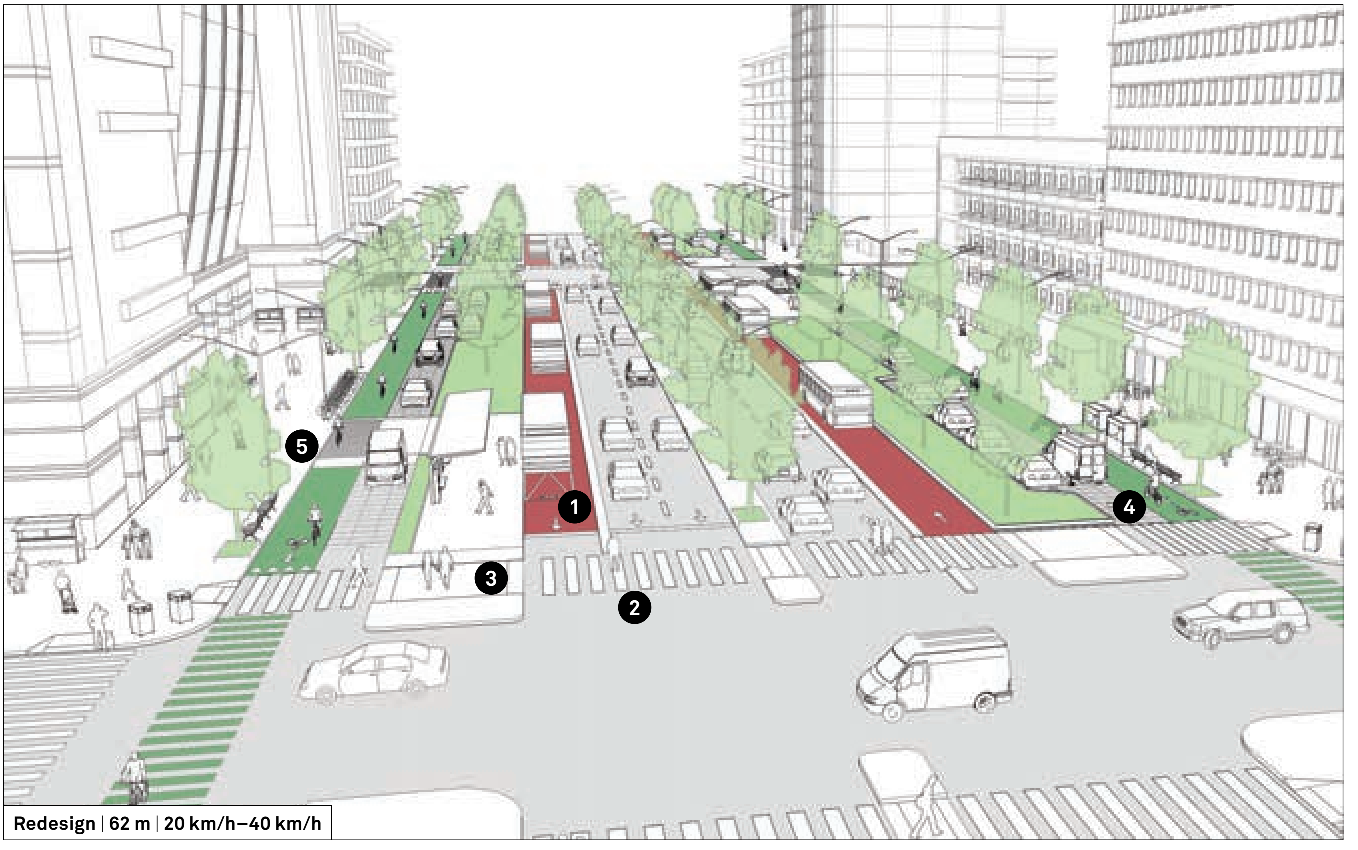
Medellín, Colombia

Irregular parking encroaches upon the sidewalk, constraining the already limited pedestrian space and reducing capacity for social and economic activities. Pedestrians are exposed to unsafe and harsh walking environments due to inaccessible and disconnected sidewalks, fast-turning traffic, lack of pedestrian crossings, and absence of landscaping and trees.

Fences on the central median, intended to restrict pedestrian behavior, often result in pedestrians crossing unsafely by jumping over or cutting through the fence.

Crossings are grade separated by overhead foot bridges or underpasses that significantly add to pedestrian travel time and are not universally accessible.

Poor drainage infrastructure causes flooding during heavy rains, and open culverts create a safety hazard for vulnerable users.



Redesign | **62 m** | **20 km/h–40 km/h**

Design Guidance

Convert one travel lane in each direction into a dedicated transit lane, and widen the medians to introduce multiple refuge islands. This creates a safer street with a more efficient transit system.

1 Provide a fully separated bus lane in a dedicated transitway with curb separation. At moderate to frequent headways, the transitway vastly improves average transit speed and reduces travel time variation.

Design transit stops as accessible boarding islands for increased efficiency and comfort. Install covered structures to provide a sheltered and comfortable waiting space for passengers. *See 6.5.5: Transit Stops.*

2 Add ground markings and low dividers to distinguish and separate transit lanes from other traffic. When occasional vehicle access into the transit lane is needed, use low vertical separation elements such as mountable curbs. To permanently prevent access into the transit lanes, use prominent vertical elements like bollards, which require added width. Provide additional enforcement while traffic behavior adjusts to new configurations.

Widen sidewalks and medians to provide universal access and increase space for pedestrian and commercial activity.

3 Install refuge islands to shorten the crossing distance for pedestrians and provide frequent at-grade signalized crossings to allow pedestrians to safely and conveniently cross the street. *See 6.3.6: Pedestrian Refuges.*

Manage cross-traffic turns to improve the safety and reliability of the through-lanes by removing conflicts and speed differentials.

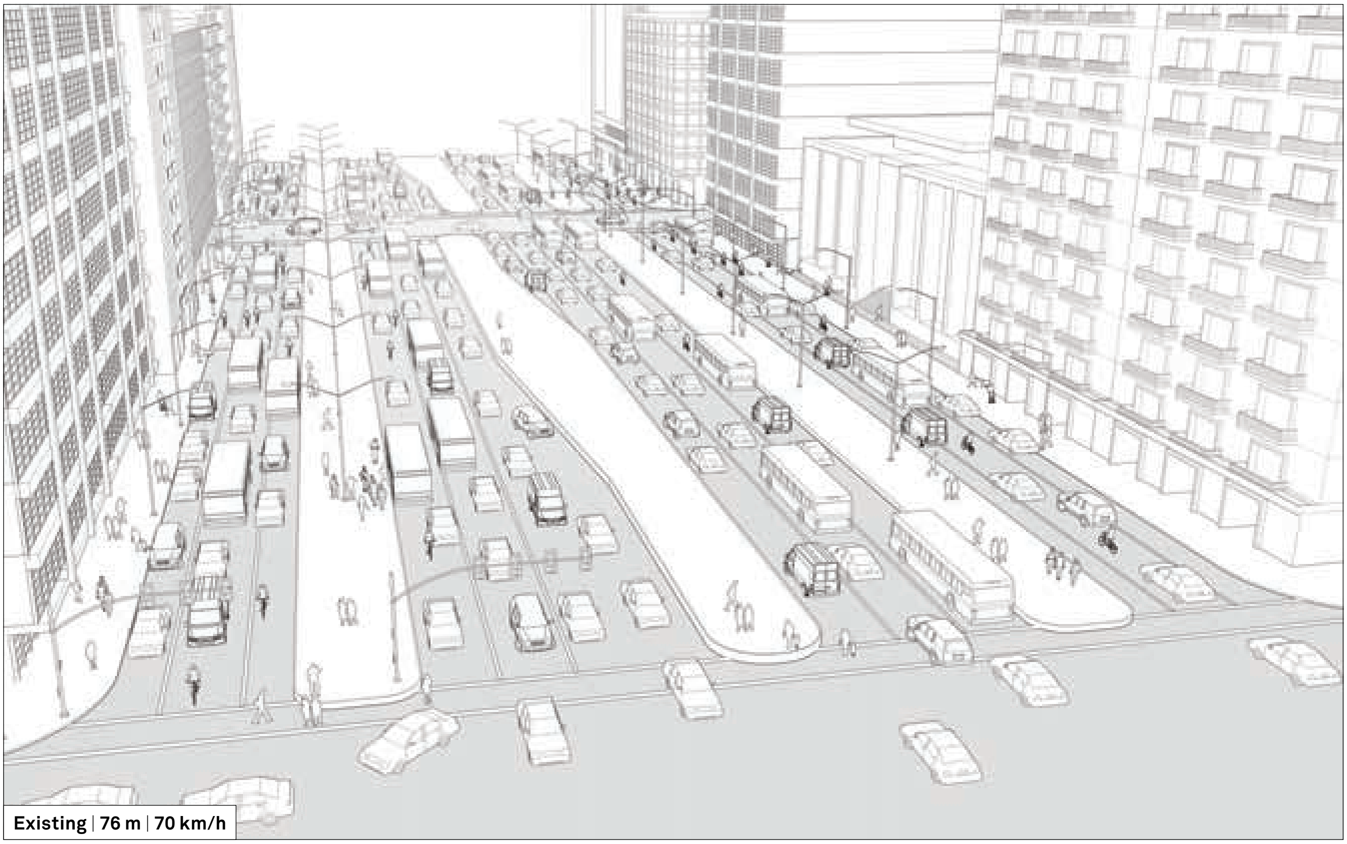
Buenos Aires, Argentina

4 Convert service lanes to slower, pedestrian and cycle-friendly streets at 20 km/h with a cycle lane in each direction. *See 9.1: Design Speed.*

5 Raise crossings for service lanes at the intersections to allow safe access from the sidewalk to the transit stop.

Add trees and landscaping to provide shade, reduce the urban heat island effect, capture stormwater, and improve the air quality.

Grand Streets | Example 3: 76 m



Existing | 76 m | 70 km/h

Existing Conditions

The large street depicted in the illustration above carries high-speed traffic in the center, separated by medians from slower service lanes on both sides. This type of street is prone to collisions where turning vehicles cross service lanes.

Such streets form a dangerous barrier between adjacent neighborhoods and limit access for many residents.

Long distances between pedestrian crossings and limited cross-street access increase traffic speed and funnel more vehicles onto the service lanes.

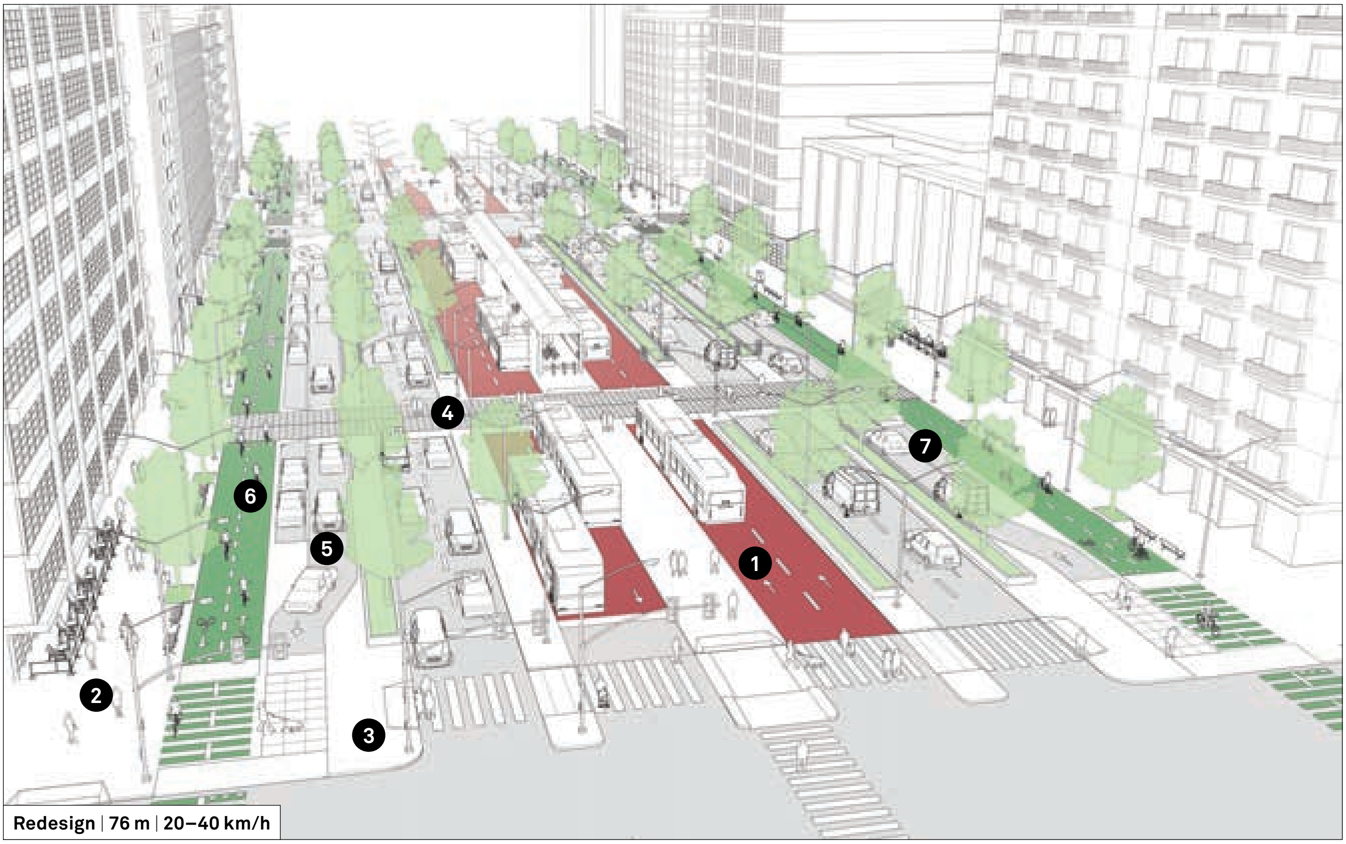
Local buses use congested service lanes or dangerous center lanes, with passengers waiting on medians without protection or shade.

Extremely long crossing distances require extended signal-cycle lengths, which create delays for all users. Pedestrians are exposed to dangerous traffic conditions while waiting mid-crossing.

In the absence of dedicated facilities for loading and parking, cycles share mixed travel lanes and compete for space with cars, trucks, and buses, leading to an unsafe cycling environment.

Turns from the central lanes block through-traffic and can result in right-angle crashes.

Bangkok, Thailand



Redesign | 76 m | 20–40 km/h

Design Guidance

Extremely wide streets should not be built in new developments. Existing conditions can be improved by the introduction of a transit spine, better management of the central lanes, and added cycle facilities.

1 Introduce a center-running Bus Rapid Transit (BRT) or light rail to increase the capacity of the street and to improve regional transportation. Passing lanes at stations allow more frequent and tiered transit service, with capacity for multiple routes. *See 6.5.4: Transit Facilities.*

2 Widen sidewalks to provide increased space for pedestrians, street furniture, and commercial activities.

3 Provide curb extensions and refuge islands to shorten crossing distances and create a safer environment for pedestrians.

4 Add raised mid-block pedestrian crossings to provide convenient access to and from transit stops. *See 6.3.5: Pedestrian Crossings.*

Manage vehicle turns by signalizing turns across traffic. Change traffic signal timing to create a reliable and reasonable speed throughout the corridor. By reducing speed differentials, injury risk is significantly reduced.

5 Convert service lanes to slower speeds of 20 km/h, raised at intersections to encourage yielding. Use distinctive paving and shade trees to help calm these lanes.

6 Add bidirectional parking-protected cycle tracks on both sides of the street to provide high-comfort mobility and safe access for cyclists. *See 6.4.4: Cycle Facilities.*

7 Designate loading zones in the service lanes.

Adding trees, plants, and landscape elements to sidewalks and medians provides shade, reduces the urban heat island effect, improves local air quality, and helps reduce the burden on stormwater infrastructure.

Guangzhou, China

Avenida 9 de Julio; Buenos Aires, Argentina

CASE STUDY

Location: Montserrat, Buenos Aires, Argentina

Population: 2.8 million
Metro: 12.7 million

Context: High-Density, Mixed-Use

Right-of-Way: 140 m

Length: 2.7 km

Cost: 150 million ARS (15.9 million USD)

Funding: Public

Max. Speed: 60 km/h

Before

After

Photo: City of Buenos Aires

The new central median of the avenue.
Photo: City of Buenos Aires

Overview

One of the widest streets in the world, Avenida 9 de Julio functioned as a highway through the city. In 2013, it was transformed by an extensive capital project to promote transit and pedestrian use in the corridor. Bus routes were moved from narrow parallel streets to the avenue, improving efficiency and clarity and increasing the avenue's capacity.

Keys to Success

- Interagency coordination.
- Vehicle fleet upgrade and driver training.
- Context-oriented design.
- Public participation and involvement.
- Commitment from the city to improve the transit infrastructure along the corridor.

Key Elements

New four-lane, center-running BRT transitway replacing four mixed-traffic travel lanes.

Level-boarding central platform.

Planted side medians.

Central walk-through pedestrian paths connecting all the stations on the avenue.

Pedestrian markings and LED signals with countdown clocks added to transit stops.

Involvement

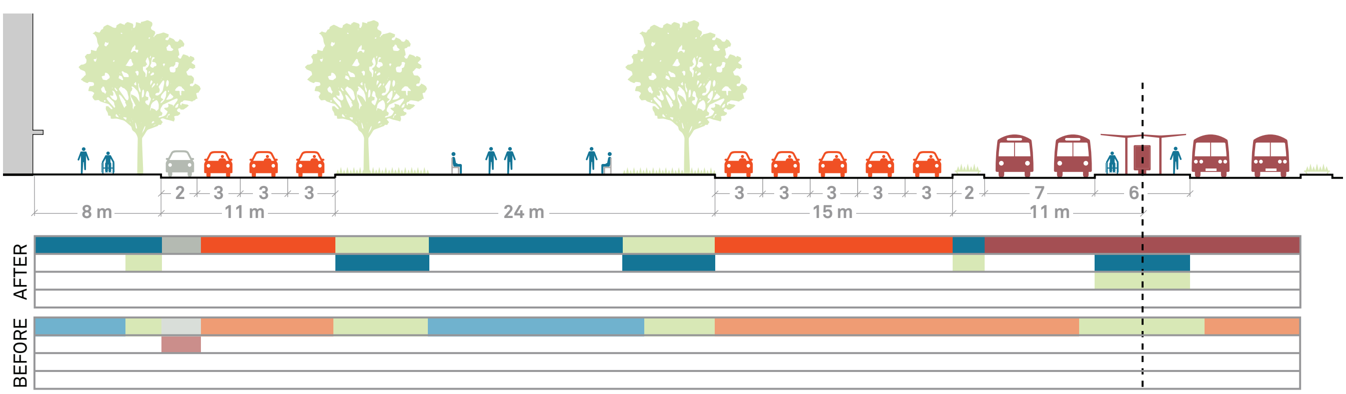
Public Agencies
City of Buenos Aires, Federal Government, bus operators

Citizen Associations and Nonprofits
Local nonprofits and associations of residents, bus drivers, taxi drivers, and shopkeepers

Goals

- Improve road safety and traffic conditions.
- Improve transit performance, efficiency, and reliability.
- Promote modal shift from private vehicles to collective transport.
- Improve air quality, reduce energy consumption and emissions.
- Reduce noise pollution.
- Redesign 60% of all streets in the central area to prioritize pedestrians and cyclists.

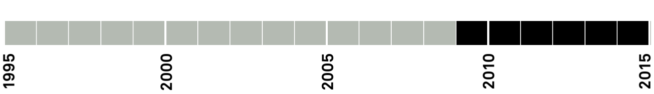
Users-bar legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking



Note: The section above illustrates half of the street's width.

Project Timeline

2009–2015 (Approximately 6 Years)



Evaluation

-98%
Decrease in the number of crashes since the creation of Metrobus

-32%
Decrease in travel times on the avenue

-63%
Decrease in bus travel times due to BRT implementation

-5615%
Reduction of tons of CO_2 equivalent per year

10.7
Special Conditions

While the fundamental principles of putting people first must apply across the globe, it is critical to also identify and improve the special conditions that are unique to each place.

Cities were settled at different times, urbanized at varying rates, and have evolved and adapted to context, climate, and environmental conditions.

Special conditions within street networks often present unique opportunities for transformation. They can be leveraged to improve the quality of public space, provide new mobility choices, and re-imagine existing urban infrastructure. These strategic projects can have a transformative impact on the larger neighborhood far beyond the boundaries of the physical intervention.

Projects may include pedestrianization of historic centers, restoring natural waterways, redesigning elevated structures, revitalizing waterfront edges, or redeveloping outdated industrial neighborhoods. This chapter discusses just a few of the less traditional opportunities for street redesign.

Work with local governments, designers, and communities to identify special conditions in neighborhoods that are ripe for reinvention.

Cairo, Egypt

10.7.1 | Elevated Structure Improvement | Example: 34 m

Existing | 34 m | 50 km/h

Elevated structures exist in many cities around the world. A century of building highways, freeways, and dedicated transit corridors above existing streets has divided many neighborhoods. Improving the spaces below and around these structures can transform disused spaces into distinctive places, revitalizing neighborhoods and reknitting communities.

Existing Conditions

The illustration above depicts a street condition with an elevated structure carrying multiple lanes of traffic.

Elevated structures, such as fly-overs, overpasses, highways, viaducts, and rail lines, have been built in many cities to avoid signalized intersections and reduce waiting time for fast-moving, motorized through-traffic or transit. In attempting to serve the needs of vehicles on the elevated structure above, cities have created uninviting spaces for users at the street level.

Below the elevated structure, a two-way street with wide travel lanes is separated by a wide median that supports the elevated structure's foundation.

The space under the elevated structure provides shade and protection from the rain, but is dark and unsafe. It may be used as regulated or unregulated parking and collects waste due to a lack of maintenance or stewardship.

Redesign | **34 m** | **30 km/h**

Design Guidance

Avoid investments in new elevated structures when they only serve a singular purpose. Opportunities for improvements should be identified throughout the city where these structures exist.

This reconstruction responds to the reallocation of space at grade, while the elevated structure remains in place.

1 Improve the safety and character of the space by introducing active uses underneath the elevated structure, such as pop-up stores, markets, cafés, and active recreation equipment.

2 Add lighting, colors, and surface treatments. When noise levels are high, install sound-reducing panels, acoustic ceilings, or buffers to mitigate noise pollution.

Redesign travel lanes in both directions to allow for wider sidewalks and new cycle facilities.

Add trees and green infrastructure elements to improve the quality of the streets and provide public health and environmental benefits, such as cleaner air, reduced heat island effect, and better stormwater management. *See 7.2: Green Infrastructure.*

Add mid-block crossings to increase and improve access to the newly activated central spaces. *See 6.3.5: Pedestrian Crossings.*

Introduce median-to-median crossings to position the spaces as a continuous mall.

New York City, USA

Addis Ababa, Ethiopia

A8ernA; Zaanstad, The Netherlands

CASE STUDY

Location: Koog aan de Zaan, Zaanstad, Amsterdam metropolitan area

Population: 0.2 million
Metro: 1.5 million

Extent: 370 m (Length)
22,500 m(Area)

Right-of-way: Elevated 27 m

Context: Mixed Use (Residential/Commercial/Institutional)

Cost: 2.1 million EUR (2.3 million USD)

Funding: Zaanstad Municipality

Max. Speed: 30 km/h

Overview

Koog aan de Zaan is a town in the Amsterdam metropolitan area, located 10 km northwest of the city. In the 1970s, a new freeway was built, brutally dividing the town's urban fabric.

For many years, the area had been neglected and was mostly used for surface parking.

The project aimed to restore the connection between the two sides of town and to activate the space under the elevated freeway.

A participatory process that involved residents, business owners, and the local government led to a proposal to redesign space underneath the structure to include a supermarket, a flower store, a fish shop, and recreational facilities including a park, a skate park, and a watersport marina that would reconnect the two sides of the city and link them to the nearby river.

Before

After

Photos: NL Architects

Key Elements

Transformation of the space underneath an elevated structure from a surface parking lot into an active mixed-use space.

Sidewalk widening and new paving materials.

Container shops and recreational spaces that can change over time.

Goals

- Reconnect the two sides of Koog aan de Zaan.
- Reactivate the space underneath the elevated structure.
- Provide residents with recreational spaces and local amenities.

Lessons Learned

Political will and the collaboration between local government and the community made possible the transformation of a space that had been neglected for more than 30 years.

Keys to Success

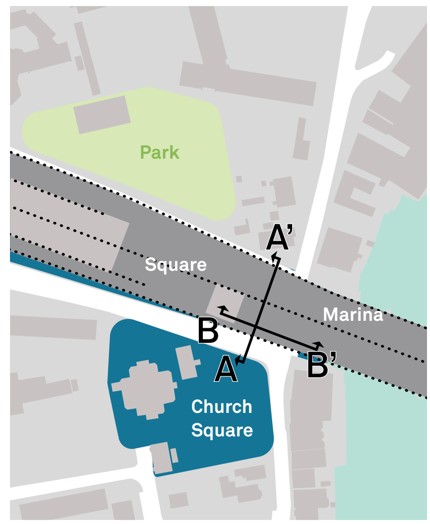
The involvement of residents and business owners in the design process informed the municipality and the designers about the community's needs and helped create a successful civic space.

Involvement

Public Agencies
Zaanstad Municipality

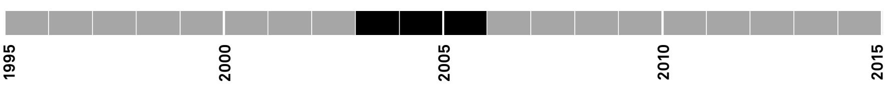
Citizen Associations and Nonprofits
Residents and business owners

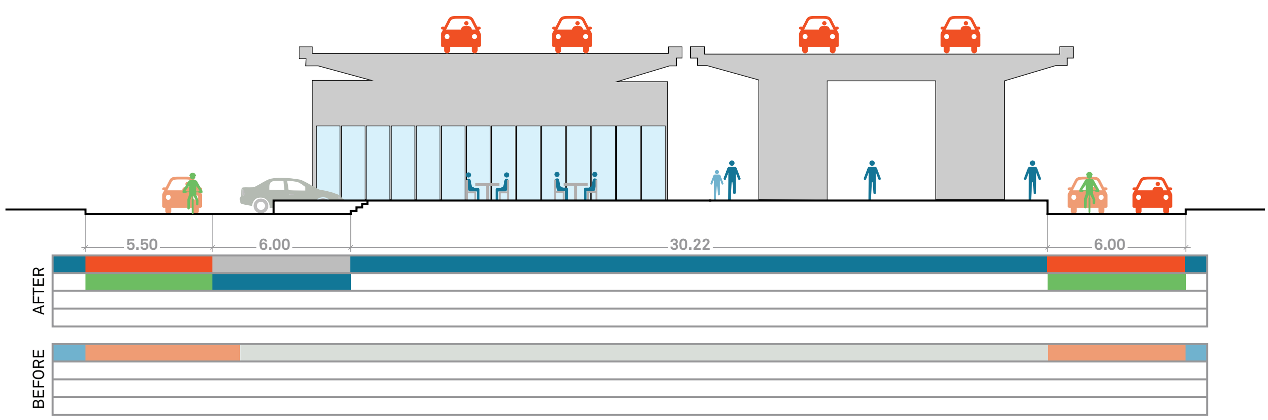
Designers and Engineers
NL Architects, Carve



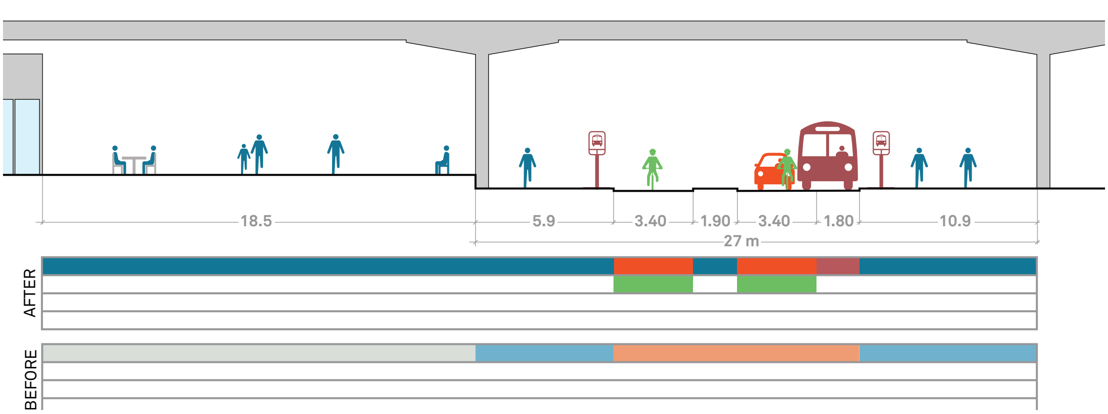
Project Timeline

2003–2006 (2 Years, 10 Months)





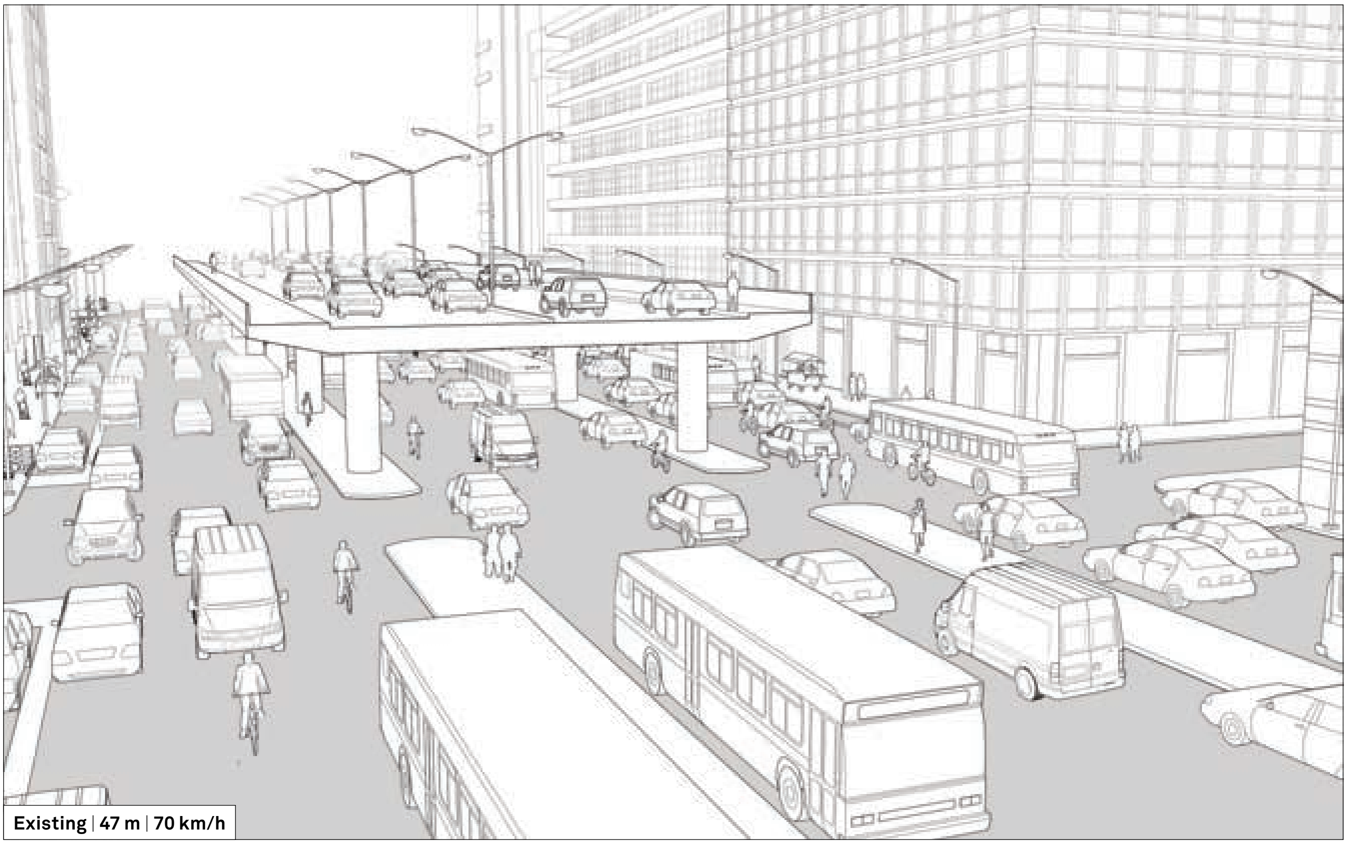
Section AA'



Section BB'

Users Legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Delivery/ Parking

10.7.2 | Elevated Structure Removal | Example: 47 m



Existing | 47 m | 70 km/h

Cities may choose to dismantle elevated structures or to avoid rebuilding ones that were damaged by natural disasters or are structurally obsolete. Such transformations create opportunities for improved public space, a more sustainable environment, increased economic activity, and a reconnected urban fabric.

Existing Conditions

The illustration above depicts a wide elevated structure that dominates, the street and carries six lanes of traffic.

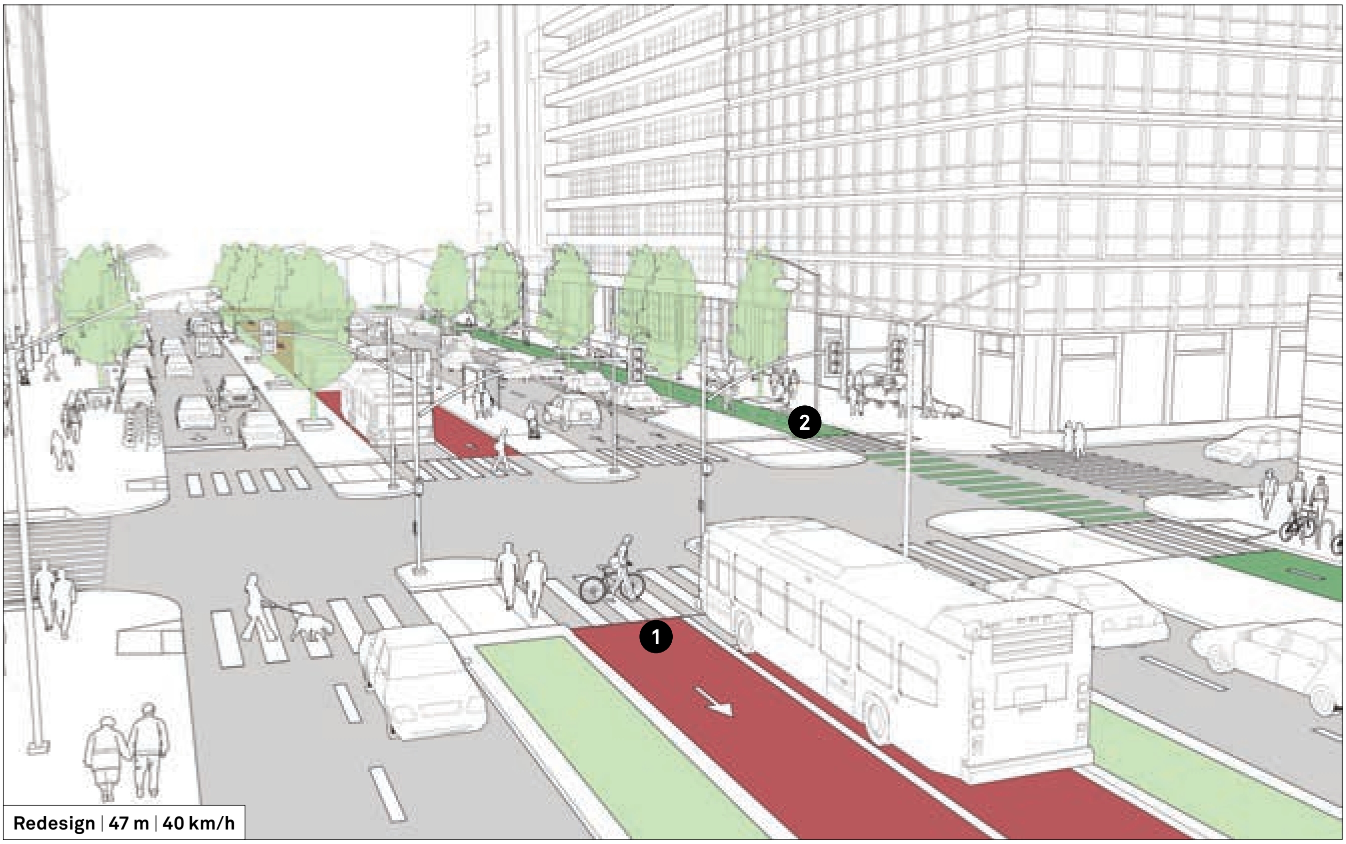
At grade, this urban street serves fast-moving through-traffic with service lanes, central travel lanes, and on-street parking. Motorists, cyclists, and transit operate in traffic with frequent conflicts due to differences in operating speeds.

Medians that carry the structure of the elevated road divide the service lanes from the central lane and block the pedestrian crossing.

A lack of marked pedestrian crossings and long distances make it impossible for pedestrian to cross the street without risking conflicts with moving vehicles.

Large structural elements severely limit visibility.

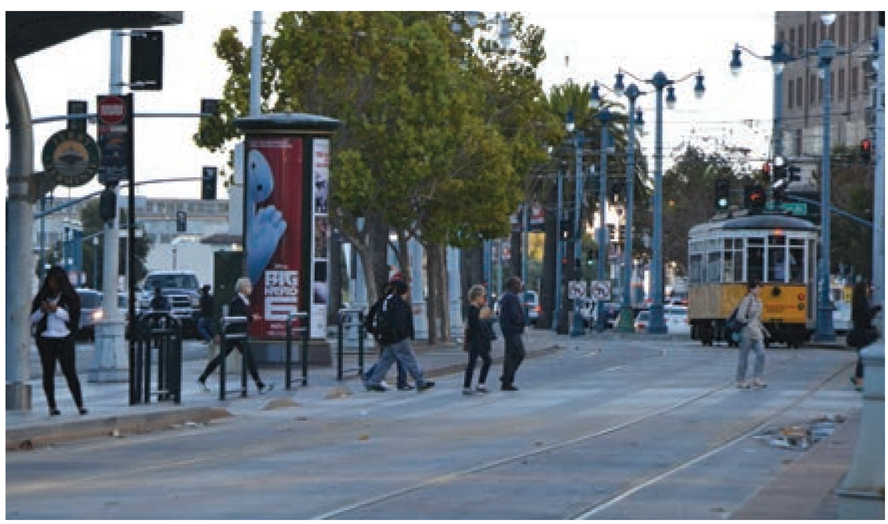
Narrow sidewalks are filled with obstacles, forcing pedestrians to walk on the street in unsafe conditions.



Design Guidance

The elevated structure is removed to create an equitable street for multiple users. Accommodating transit lanes increases the street's capacity. Cycle facilities and an improved pedestrian realm result in safer and more-comfortable experiences for walking and cycling.

1 Add dedicated, center-running transitway with wide medians that serve as transit boarding areas, pedestrian refuge islands, and green infrastructure opportunities. *See 6.5.4: Transit Facilities.*



San Francisco, USA

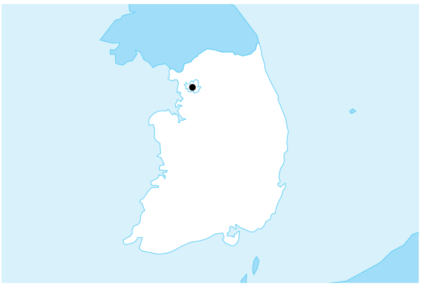
Maintain curbside parallel parking, adding curb extensions near intersections and mid-block crossings to shorten pedestrian crossing distances and maintain local business access.

2 Add a dedicated, bidirectional cycle track on one side of the street.

Widen sidewalks to help revitalize building frontages and attract new commercial uses. Provide space for street vendors. *See 6.3.4: Sidewalks.*

Add trees and landscaping to sidewalks to improve air quality, stormwater management, and to provide shade.

Cheonggyecheon; Seoul, South Korea



Location: Jung Gu (Central District), Seoul, South Korea

Population: 10.1 million
Metro: 25.6 million

Extent: 5.8 km (Length)
292,000 m(Area)

Right-of-Way: 50 m

Context: Mixed-Use (Residential/ Commercial)

Cost: 386,739 million KRW (345.2 million USD)

Funding: Seoul Metropolitan Government

Project Sponsors: Seoul Metropolitan Government

Overview

The Seoul Metropolitan Government decided to dismantle the 10-lane roadway and the 4-lane elevated highway that carried over 170,000 vehicles daily along the Cheonggyecheon stream. The transformed street encourages transit use over private car use, and more environmentally sustainable, pedestrian-oriented public space. The project contributed to a 15.1% increase in bus ridership and a 3.3% increase in subway ridership between 2003 and 2008. The revitalized street now attracts 64,000 visitors daily.

Before

After

Photos: Seoul Metropolitan Facilities Management Corporation

Goals

- Improve air quality, water quality, and quality of life.
- Reconnect the two parts of the city that were previously divided by road infrastructure.

Lessons Learned

Innovative governance and interagency coordination were critical to the process.

Public engagement, with residents, local merchants, and entrepreneurs, was important to streamlining the process.

Reducing travel-lane capacity resulted in a decrease in vehicle traffic.

Involvement

Public Agencies
Central Government, Seoul Municipality, Seoul Metropolitan Government, Cultural Heritage Administration

Private Groups and Partnerships
Cheonggyecheon Research Group

Citizen Associations and Unions
Citizen's Committee for Cheonggyecheon Restoration Project

Designers and Engineers
Seoul Development Institute urban design team, Dongmyung Eng, Daelim E&C

Close to 4,000 meetings were held with residents. A "Wall of Hope" program was developed to encourage involvement and resulted in 20,000 participants.

Evaluation

+76%
Increase in pedestrian activity

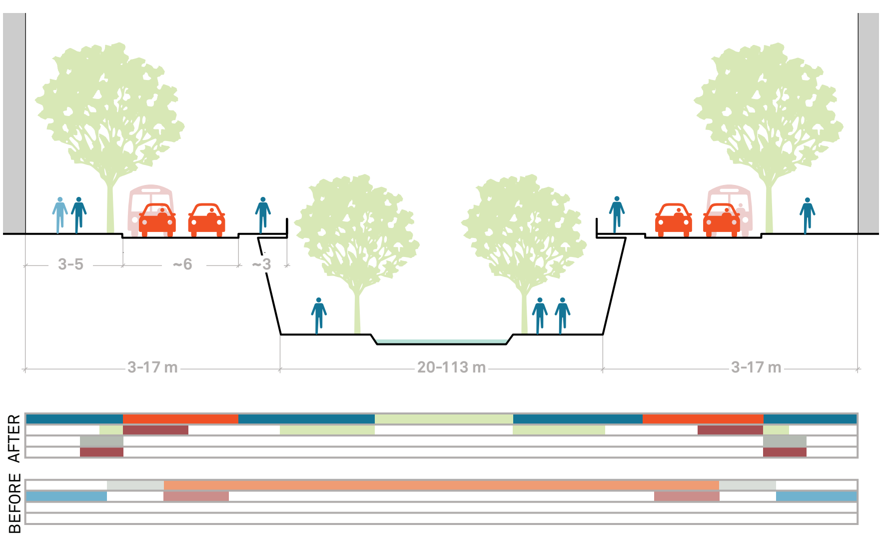
-4.5%
Reduction in the urban heat island effect

-45%
Decrease in vehicle volume

-10.3%
Decrease in air pollution

+15.1%
Increase in bus ridership

+3.3%
Increase in subway ridership



Key Elements

Removal of elevated highway concrete structure.

Daylighting of a previously covered urban stream.

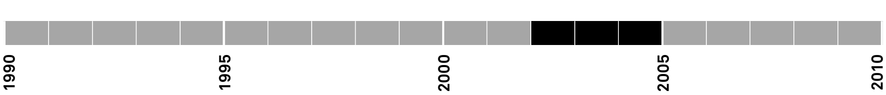
Creation of an extensive new open space along the daylighted stream.

Creation of pedestrian amenities and recreational spaces (two plazas, eight thematic places).

Construction of 21 new bridges, reconnecting the urban fabric.

Project Timeline

2002–2005 (3 Years, 6 Months)



Users-bar legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Delivery Parking

10.7.3 | Streets to Streams | Example: 40 m

Existing | 40 m | 60 km/h

Daylighting streams and rivers allows cities to uncover buried waterways in order to improve water quality, water management, and biodiversity. Transforming disused roadbeds back to streams offers an opportunity to provide new public spaces and create new destinations within the city.

Existing Conditions

The illustration above depicts a two-way street with central travel and service lanes located above a channelized natural waterway.

Streams and rivers are often polluted by industrial and residential uses and are deemed to be in the way of new development. They are often channeled into underground pipes and paved over. Today however, cities around the world are looking to rebalance the relationship they have with their natural environment.

Design Guidance

Overlay historic hydrology maps of the city with current street plans to identify natural watercourses. Consult environmental agencies, and advocacy groups, as well as planning and transportation agencies about known rivers, streams, or street-channeling projects implemented in past decades. *See 1.4: Streets for Environmental Sustainability.*

Identify daylighting sites by considering areas suffering from frequent flooding, or neighborhoods lacking in public open space.

Collect drawings, maps, and data to analyze the detailed right-of-way dimensions, traffic flow, constructed buildings, hydrology, and other existing conditions.

Discuss the potential pedestrianization of the street and daylighting concept with local officials and communities, bringing examples from other places to help demonstrate the multiple benefits. *See 2.5: Communication and Engagement.*

Consider a temporary closure of the relevant street sections, and program events to increase public awareness and build community interest. *See 10.7.4: Temporary Street Closures.*

Work with experts to develop a strategic plan, action items, engineering, and budgets for the proposal. Work with local artists and designers to visualize the potential transformation.

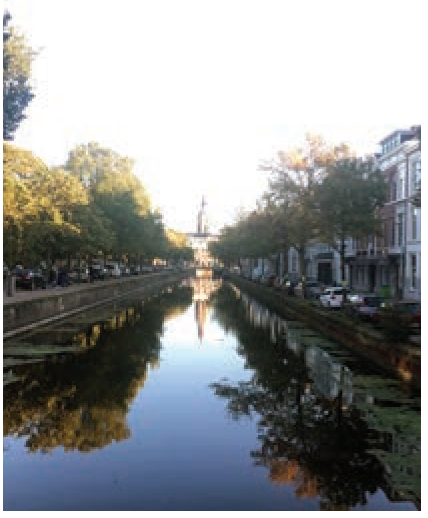
1 Add public seating to invite people to use the new water's edge.

2 Specify plant species that are durable and compatible with the local climate, soil conditions, and annual rainfall. *See 7.2.1: Green Infrastructure Design Guidance.*

3 Use permeable pavers over adjacent pedestrian areas to increase water infiltration.

Measure and document environmental benefits such as groundwater recharge.

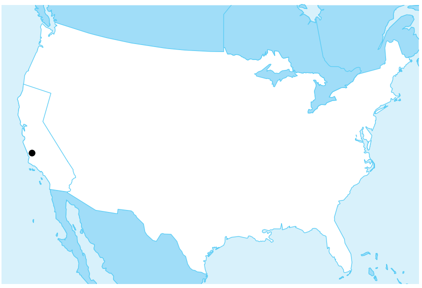
Create a pedestrian-friendly environment with raised intersections and continuous pedestrian crossings to slow traffic.



The Hague, The Netherlands. At Noordwal-Veenkade an on-street parking lot was removed to uncover the canal.

21st Street; Paso Robles, USA

CASE STUDY



Location: Paso Robles, California, USA

Population: 30,000

Length: 640 m–5 blocks

Right-of-way: 24 m

Context: Residential and Commercial Main Street

Cost: 2.5 million USD

Funding: City of Paso Robles and Urban Greening Grant from the California Strategic Growth Council

Overview

This is a commercial corridor and one of four railroad crossings in north Paso Robles, California. It provides a key connection between a local school and a city park, and access to the California Mid-State fairgrounds. When the city was developed in the 1880s, the street was paved over buried Mountain Springs Creek, a tributary of the nearby Salinas River that drains 1,200 acres, and few infrastructure provisions were made for the creek. As the city grew and upstream development accelerated, polluted stormwater runoff increased. Before the transformation, large storms flooded the street and adjacent properties, causing erosion and creating traffic hazards.

Early in the design process, team members recognized the overlapping benefits of designing for safety, environmental sustainability, and high-quality public spaces. The newly reconfigured corridor transformed five city blocks by calming traffic, improving cycle and pedestrian mobility, and introducing a natural drainage into the transportation network, increasing groundwater recharge.

Before

After

Photos: SvR Design Company (above), CannonCorp Engineering (below)

Goals

- Reduce the frequency and severity of street flooding and increase stormwater infiltration.
- Improve pedestrian and cyclist safety.
- Reduce traffic speeds by incorporating traffic calming devices.
- Increase shade and aesthetic appeal by planting trees and drought-tolerant plants.

Lessons Learned

After being fined for an illicit discharge to the Salinas River, the city worked with the state water board to redirect the fine to fund the concept plan, which was the basis for an application for a State Urban Greening Grant that funded final engineering and construction.

Working with a mix of public, private, and non-governmental organizations allowed for broader support and access to innovative funding while creating strong and diverse project advocates.

Keys to Success

Leverage professionals with experience in emerging green street technologies to support the expertise of local engineers.

Design elements along the corridor respond to the right-of-way constraints as well as the stormwater and mobility goals.

Involvement

Public agencies
City of Paso Robles (owner)
California Central Coast Water Board

Private Group and Partnerships
California Central Coast Low Impact Development Initiative

Citizen Associations and Unions
Stakeholder Advisory Group (adjacent property and business owners)

Designers and Engineers
SvR Design Company, CannonCorp Engineering, Earth Systems Pacific

Evaluation

-30%

Decrease in average speed from 49 km/h to 38 km/h

-20%

Decrease in area dedicated to vehicular travel

0

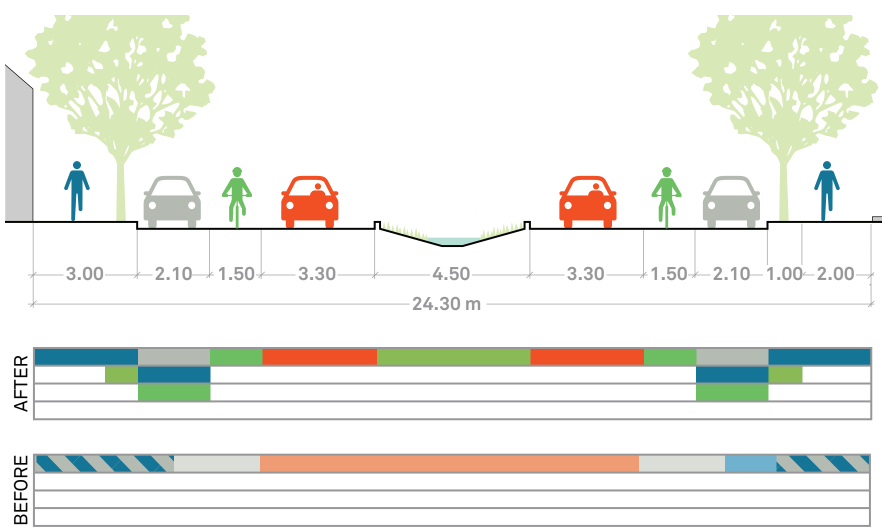
No crashes (vehicular, cycle, pedestrian) since the completion

+80%

Increase in planted trees from 48 to 88

15,000 L

Water treated and infiltrated for every millimeter of rain



Key Elements

Stormwater management, including green infrastructure, is provided.

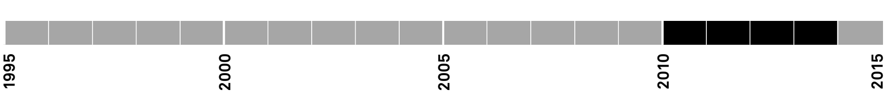
Widened sidewalks to provide a 2 m-minimum clear path.

On-street cycle lanes are provided.

Traffic calming elements include curb extensions, pedestrian crossing striping, in-pavement lighting, and signage.

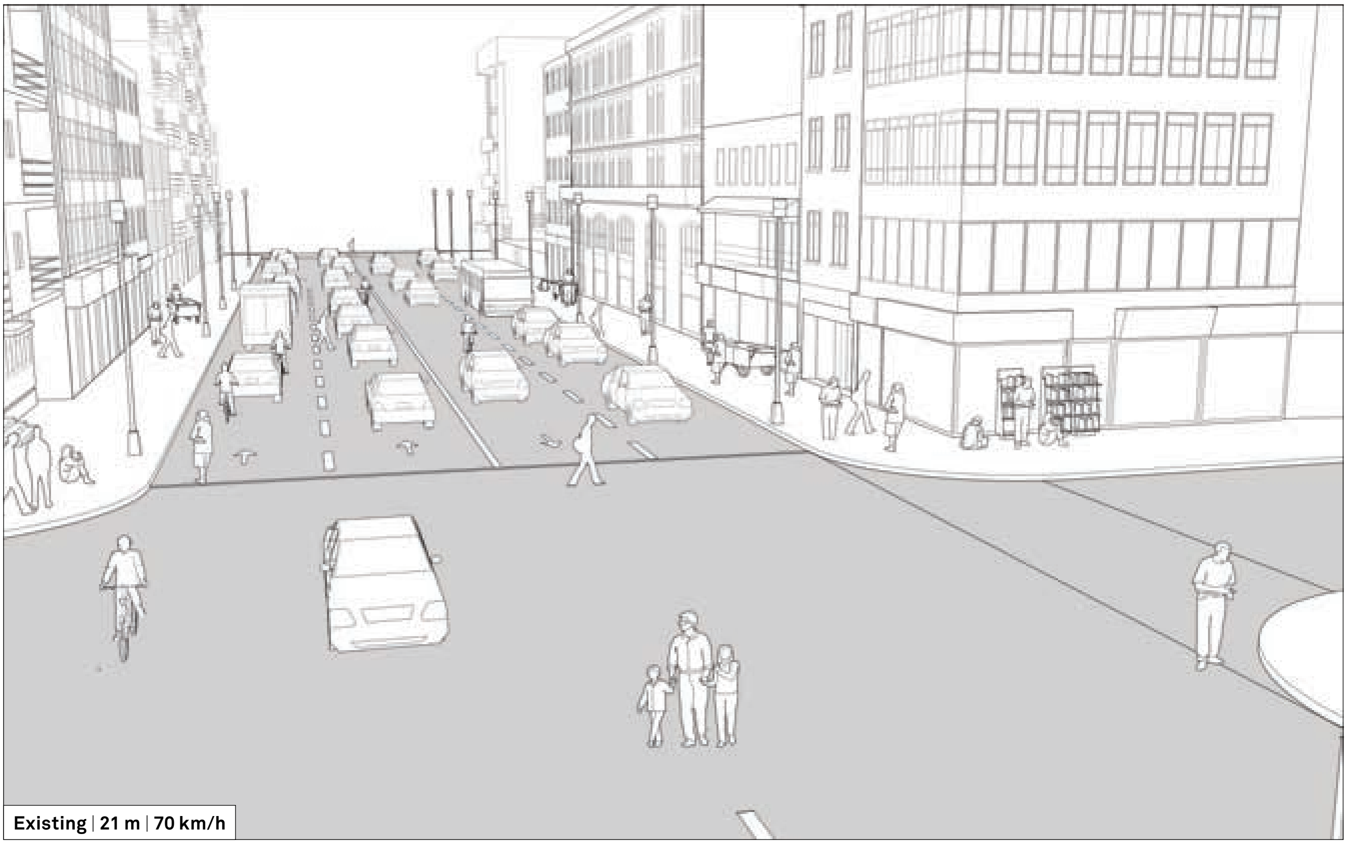
Project Timeline

April 2010–March 2014 (Approx. 3 Years, 11 Months)



Users-bar legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking

10.7.4 | Temporary Street Closures | Example: 21 m



Existing | 21 m | 70 km/h

Temporary street closures for street fairs, markets, block parties, play streets, and open streets provide an opportunity to rethink the space by allowing people to experience a range of different activities. Temporary closures open streets to people, activate streets, and showcase businesses and communities.

Overview

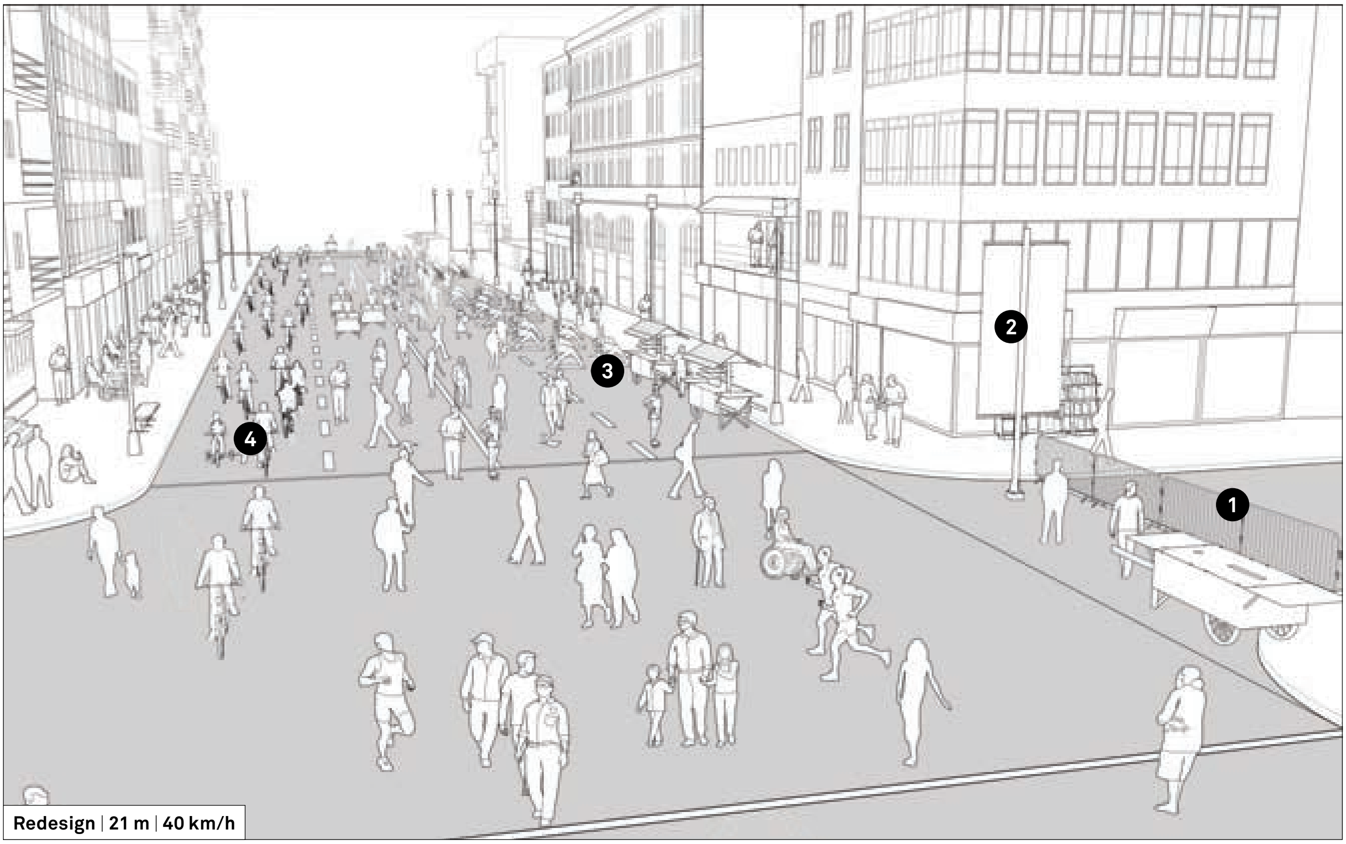
Depending on a street's usage and characteristics, temporary closures can take multiple forms, emphasizing active recreation and exercise, commercial activity or food festivals, or celebrating local art and culture.

When closed to traffic and supported by activities and programs, the street provides additional reasons for neighbors to socialize and for children to play, building stronger communities.

When occurring on a regular or longer-term basis, temporary street closures can offer an opportunity to promote larger public health goals that encourage people to be more physically active, while simultaneously supporting environment-friendly goals that promote cleaner modes of transportation.[13]

Data collection can help document and communicate the benefits of temporary street closures, and ultimately help advocate for more permanent changes.

Temporary closures can produce different amounts and types of waste, requiring additional cleaning services.



Design Guidance

Street Selection. When large areas are being closed to traffic, streets should be carefully considered within the larger network and clearly communicated in advance of the event. Select streets that benefit multiple neighborhoods. *See 6.3.2: Pedestrian Networks.*

Destinations. Smaller street closures of a few city blocks can add open space to adjacent destinations such as schools, transit stops, and museums. *See 5: Designing Streets for Place.*

1 **Enforcement.** While police enforcement may prove helpful, it is not always necessary or desirable. A temporary control device or barrier should be used to ensure that vehicles do not enter the space.

2 **Signage.** Where closures are weekly or daily, ensure that hours and days are clearly indicated on regulatory signage.

3 **Programming.** Closures are most successful when they are programmed with events and activities throughout the day. Programs may include performances, invited gatherings, food-related events, and other activities.[14]

4 **Cycles.** Allow cyclists to ride through temporary closures, yielding to pedestrians. Open Streets or Ciclovía events that follow longer routes should actively encourage cyclists by providing dedicated space and amenities.

Equipment and Amenities. Provide seating, tables, food stalls, recreational equipment, and lighting to help activate the space.

Loading. When streets are closed, arrangements should be made with local businesses for deliveries and unloading during morning and evening hours.

Branding. Consider local context and intended audiences and participants when branding and marketing these street projects.

Night Closures. Evening closures can allow events such as concerts, movie screenings, dining, and other activities. Additional lighting and police enforcement are recommended. Noise and other disruptions may be a consideration when locating these in residential neighborhoods.

Types of Temporary Street Closures

Temporary street closures restrict motorized access to a street while allowing pedestrians, and in some cases, cyclists, roller bladers, or skateboarders. While many streets are periodically closed to traffic for special events, the examples below refer to streets with a regularly scheduled closing, such as market streets, Ciclovías, or Open Streets. *See 8.4: Network Management.*

Car-Free Days and Ciclovías

Major streets can be closed on weekends to motorized traffic. These closures typically allow pedestrians, cyclists, and other recreational users, as well as limited curbside activities. Successful examples include New Delhi Raahgiri, New York City Summer Streets, and Bogota Ciclovía.

São Paulo, Brazil

Play Streets

Low-volume local streets can be closed for a specific portion of the day or weekend for play and recreation. Play streets are often adjacent to playgrounds, schools, or residential areas with limited park space. They can help to temporarily address a lack of public space in neighborhoods of need.

New York City, USA

Market Streets

Streets adjacent to public parks, landmarks, or key corridors can be fully or partially closed for a food fair or farmers market. Markets may be seasonal and open only during daylight hours, or on some days of the week.

Hong Kong, China

Seasonal Closures

Seasonal closures can be used as a strategy to test a long-term closure, to build public support for transformation, or to offer additional public open space for specific seasons. La Playa in Medellín, Colombia has hosted monthly closures, and Paris Plages in Paris and has seen seasonal closures develop into permanent pedestrianization.

Medellín, Colombia

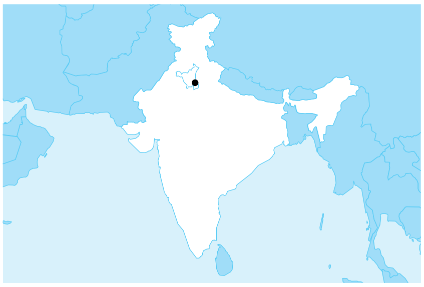
Special Events

Support local festivals, celebrations, parades, concerts, and other events by closing multiple streets for a single or a few days.

Kolkata, India

Raahgiri Day; Gurgaon, India

CASE STUDY



Location: Gurgaon, National Capital Region, Haryana, India

Population: 0.8 million
Metro: 24 million

Extent: 1 km
Area: 1,000,000 m²

Right-of-way: 45 m

Context: Mixed Use (Residential/ Commercial)

Cost: 1,000 USD (operation and branding)

Funding: Private institutions and corporations

Speed: N/A (car free)

Overview

Raahgiri Day is India's first sustained car-free citizen initiative that was developed to encourage pedestrians, cyclists, and other non-motorized modes.

Raahgiri Day began in Gurgaon (National Capital Region, Delhi) on November 17, 2013 and was expanded to the entire city of New Delhi and adopted in 36 other Indian cities under the same or similar names. Roughly 350,000 people have participated in these events since.

Dedicated stretches of roads are blocked to motorized traffic and allow only pedestrians and cyclists for 4–5 hours every Sunday.

Raahgiri Day has been chosen as one of the 24 most inspiring stories for "Pathways to Green Cities" by the Global Advisory Committee of the Earth Day Network. The Ministry of Urban Development (MoUD) has documented Raahgiri Day as a best practice in urban transportation in Indian cities.


Active Recreation


Games for All


Organized Events

Photos: Embarq India

Key Elements

Several streets in the neighborhood are temporarily pedestrianized to allow residents and visitors to perform and participate in a series of recreational activities.

Street closures are repeated at regular times and locations to establish use patterns.

Goals

- Provide a more pedestrian-friendly space for residents, visitors, and business owners.
- Reduce air pollution.
- Raise awareness about road safety.
- Increase quality of life in Gurgaon.

Issued Addressed

Road Safety. More than 140,000 people annually die in India due to road accidents, the majority of whom are pedestrians and cyclists who are not respected on the roads.

Air Pollution. According to a WHO report, more than 62,000 premature deaths occur each year in India due to air pollution.

Physical Inactivity. The WHO report also estimates that more than 43,000 premature deaths occur annually in India because of physical inactivity, largely due to unhealthy lifestyle choices.

Inclusive Development. Many urban areas are becoming exclusive as there is no formal mechanism to facilitate interaction between different sections of society. The outcome of this segregation is manifested in social unrest.

Involvement

Raahgiri Day is the result of active contribution by founding partners and citizen groups, media outlets, resident welfare associations (RWA), schools, NGOs, private organizations, recreational groups, and others. These groups immediately connected with the idea, and helped spread the word in their communities.

Public Agencies
Ministry of Urban Development, High Court of Punjab and Haryana, Gurgaon Municipal Corporation, Gurgaon Police, Delhi Development Authority, New Delhi Municipal Council, Delhi Police, Bhopal Municipal Corporation

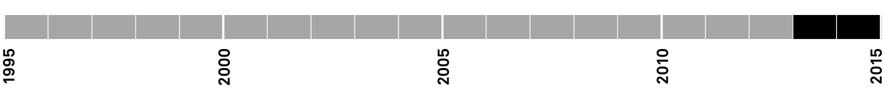
Private Group and Partnerships
Many private institutions, corporations, global brands, media companies, cycling/walking/running groups, dance/music academies, yoga/aerobics/dance institutes

Citizen Associations and Unions
Local residents associations, citizen groups

Nonprofits and Institutions
Raahgiri Foundation [lead]
EMBARQ India, Duplays, IAmGurgaon, Pedal Yatri, and Heritage School

Project Timeline

November 2013–Today



Evaluation

73%
Participants liked Raahgiri

-49%
Decrease in air pollution

+29%
Increase in retail sales

79%
Shop owners liked Raahgiri

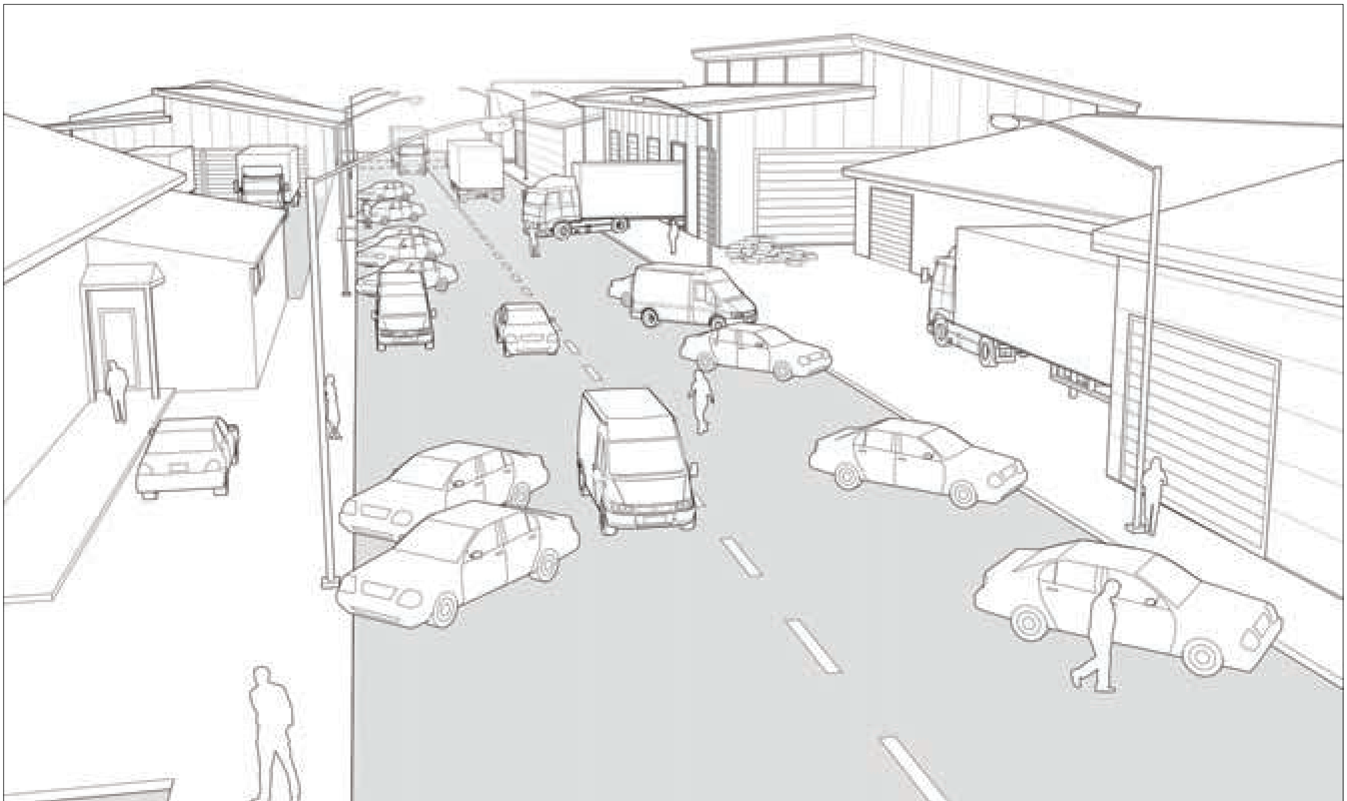
-16%
Decrease in noise level

+14%
Increase in pedestrian volume

71%
Supported Raahgiri beyond March 2014

+87%
Participants have started walking or cycling for short trips

10.7.5 | Post-Industrial Revitalization | Example: 20 m



Existing | 20 m | 50 km/h

As cities around the world shift from economies based on industry and manufacturing to service economies, large, formerly industrial areas are transformed to accommodate other uses. Characterized by wide streets lined with vacant warehouses and factories, these areas offer an opportunity to design streets that respect the neighborhood's heritage while inviting and accommodating different uses.

Existing Conditions

The illustration above depicts a wide street that runs through an underutilized industrial area where a new development is planned.

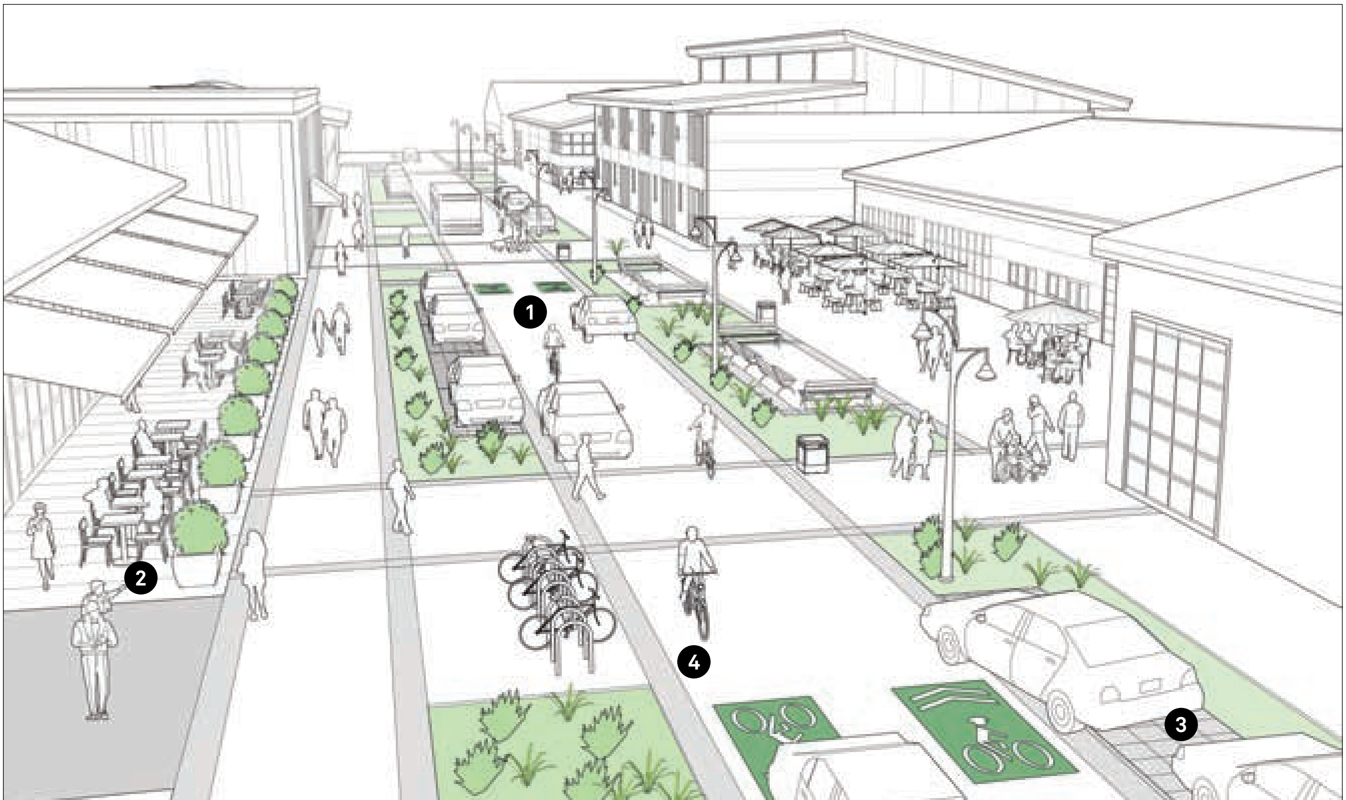
This two-way street contains two wide travel lanes in each direction, designed to accommodate large trucks. Perpendicular parking lines both sides of the street.

Traffic volumes are low, but vehicles travel quickly.

Sidewalks are narrow, inactive, or non-existent, and are lined with blank walls, loading docks, and fences.

These formerly industrial areas may be the target of extensive urban regeneration, potentially channeling significant private and public investment.

New York City, USA



Redesign | **20 m** | **20 km/h**

Design Guidance

New uses attracted by building retrofits and zoning changes require these streets to be redesigned for multiple users. *See 5: Designing Streets for Place.*

Maintaining some of the industrial qualities is important in developing a distinctive character for the neighborhood.

A new transit service is provided in both directions, shared with mixed traffic.

1 Reduce the street width to a single travel lane in each direction, widen sidewalks, and provide green infrastructure. Bioremediation strategies can help to mitigate effects of past industrial uses and safely allow residential and commercial uses.

2 Include wide frontage zones on sidewalks, new development, and reused warehouses to support active sidewalks.

Add street furniture and public seating to enhance the pedestrian experience.

3 Provide parallel parking and loading spaces in small sections, alternating with rain gardens and trees.

4 Develop the street as a shared space by removing curbs and markings, and reducing the width of the roadbed. Encourage active users to use the entire right-of-way and maintain low travel speeds. *See 10.4: Shared Streets.*

Jellicoe Street; Auckland, New Zealand

CASE STUDY

Location: Wynyard Quarter, North Wharf, Auckland, New Zealand

Population: 1.4 million
Metro: 1.5 million

Length: 400 m
Area: 14,000 m^2

Right-of-way: 23 m

Context: Before: Industrial. After: Mixed-Use.

Cost: 24 million NZD (15 million USD)

Funding: Public

Project Sponsors: Auckland Waterfront Development Agency

Max. Speed: 30 km/h

Overview

The transformation of Jellicoe Street is part of the larger revitalization project of the Wynyard Quarter, from an industrial port area to an active and livable waterfront neighborhood. The area is located on the edge of the city, close to the harbor, on contaminated land.

Public space has been designed to catalyze development and foster the conversion of old hangars and warehouses into a cultural and recreational strip.

The street was transformed from an industrial service road to a lush pedestrian boulevard.

The innovative approach that integrated sustainability measures has become the new benchmark for citywide street-planting strategies.

Before

After

Photos: Top - Auckland Council

Key Elements

Rain garden network integrated into the street design.

Limited vehicle access.

Curbs removed (shared-space approach).

Integration of light rail (tram).

Use of native and local plants.

Goals

- Create a unique destination and a civic space.
- Bring recreational activity to the site.
- Transform the area while preserving the industrial heritage.
- Achieve an environment that is well connected yet offers distinctly different experiences.

Lessons Learned

Although surface treatment reduced speeds, the driver behavior forced the Waterfront Development Agency to implement controls such as wheel stops adjacent to rain gardens and dotted yellow lines to restrict parking.

Usage of parking spaces was monitored and changes were made accordingly, including replacing parking with cycle parking or loading zones.

The following measures were used to create a more sustainable street environment:

- Water-sensitive design including capturing, treating, and reusing stormwater.
- Reuse of existing site materials such as concrete blocks from a nearby cement factory.
- Promotion of healthy activities, environmental education, and social interaction.

Evaluation

+1293%
Increase in pedestrian activity

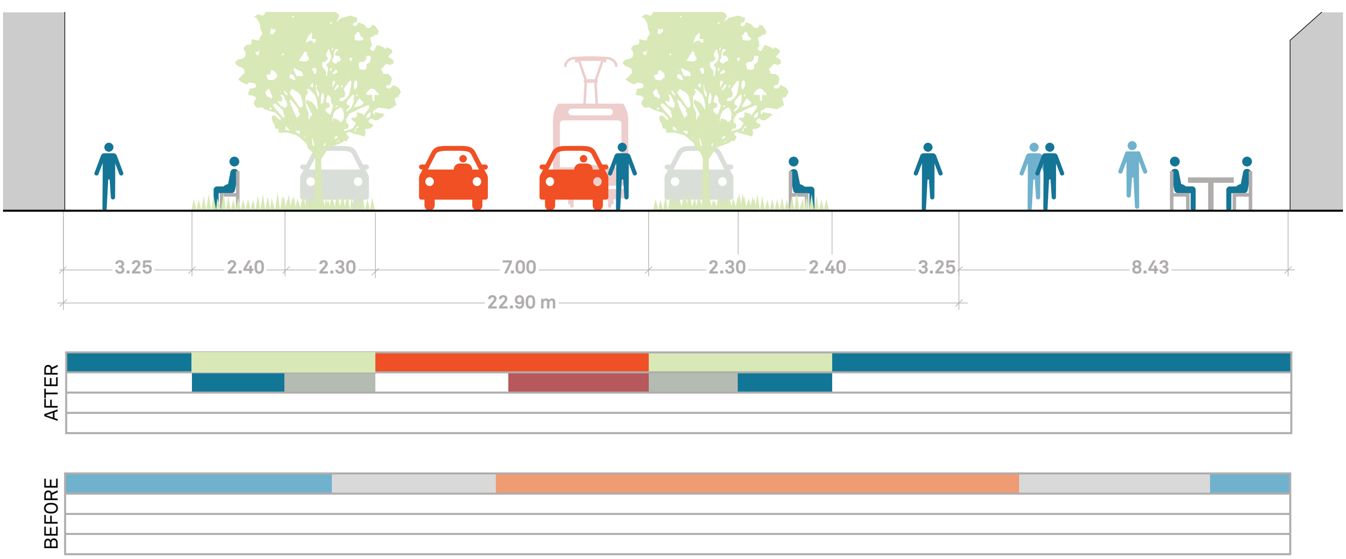
+67%
Increase in cycle volume

+57%
Increase in bus ridership

-456%
Decrease in morning vehicle volume

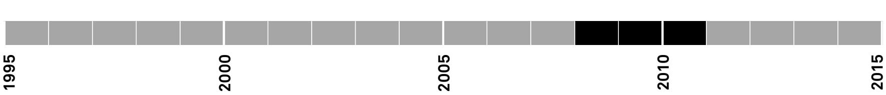
-451%
Decrease in afternoon vehicle volume

+533%
Increase in carbon absorption with additional trees



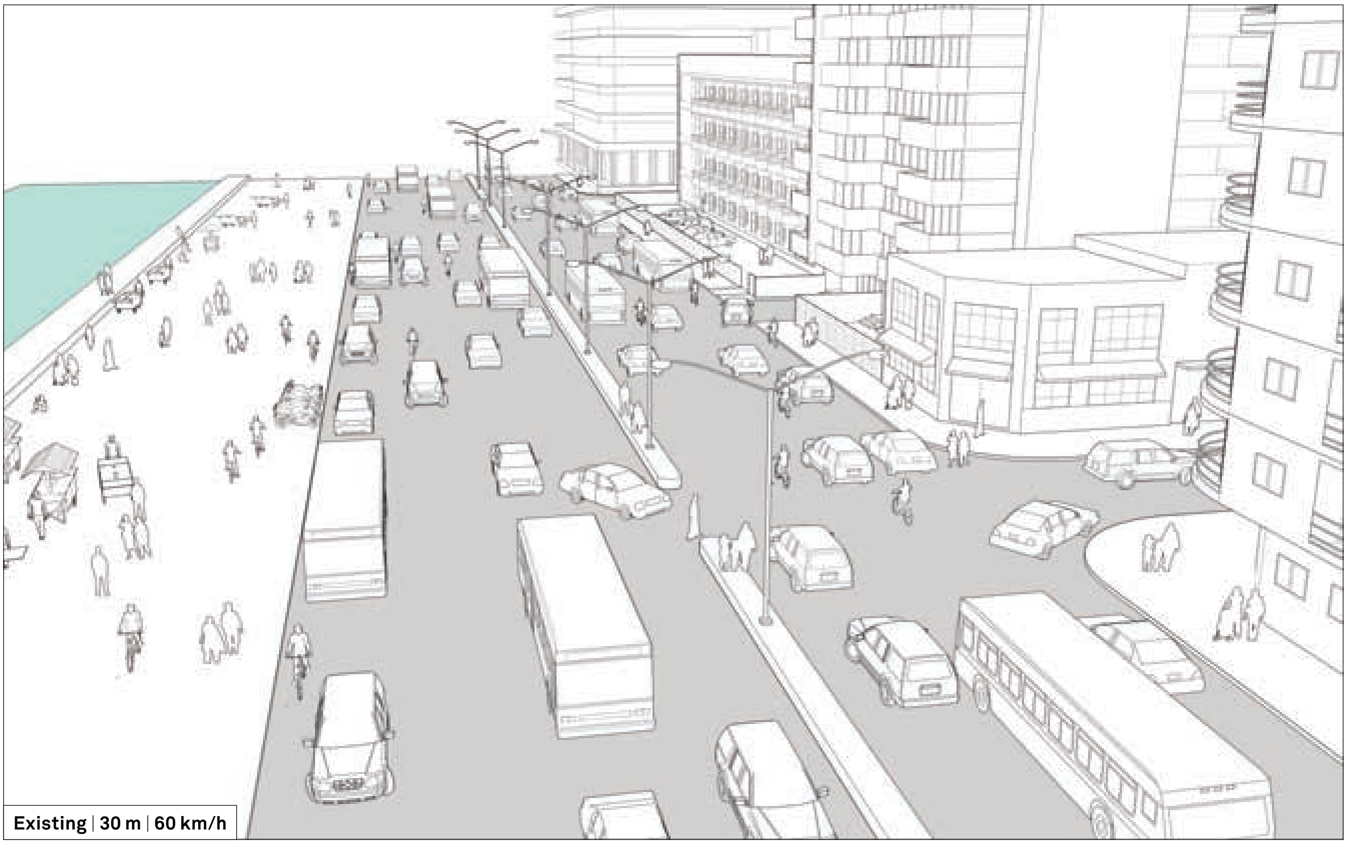
Project Timeline

June 2008–August 2011 (3 years, 3 months)



Users-bar legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Parking

10.7.6 | Waterfront and Parkside Streets | Example: 30 m



Existing | 30 m | 60 km/h

Waterfront promenades and neighborhood parks are key destinations in many cities. Designing the streets adjacent to these areas can help extend the public space into surrounding neighborhoods and invite multiple users to enjoy them.

Existing Conditions

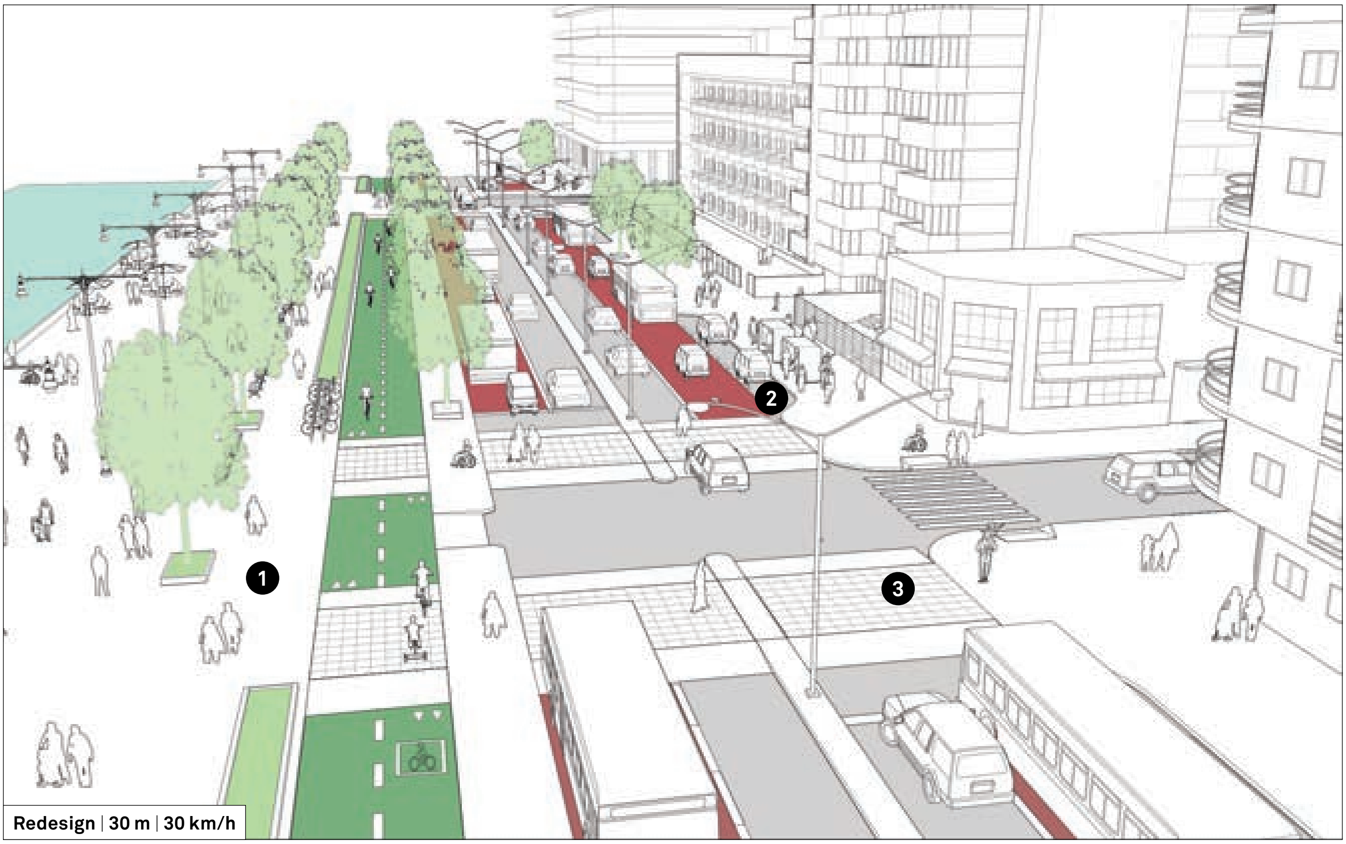
The illustration above depicts a two-way waterfront drive with four travel lanes in each direction, effectively severing the waterfront from the adjacent neighborhood.

Limited or no pedestrian crossings and narrow central medians create an unsafe pedestrian environment.

Design Guidance

Transform the waterfront or park edge into a vibrant public park and an active multimodal corridor. Provide wide, high-capacity cycle tracks, wide walking paths, and high-quality transit stops and service.

Design and install street lighting so that both the building and waterfront or park sides of the street are safe and well lit. The waterfront or parkside edge requires greater lighting and visibility consideration, as it likely receives little light or "eyes on the street" from active frontages. *See 7.3.1: Lighting Design Guidance.*



❶ Reduce the number and width of travel lanes to widen park and promenade space.

Dedicate space for collective transport to increase the street capacity. Transit can be accommodated in a side-running transitway thanks to the lack of crossing conflicts.

❷ Add taxi drop-off areas and selected parking areas for accessible parking. Locate these to minimize conflict with transit, cycle, or travel lanes.

Design specific gateways to access these destinations as safe intersections between all users.

Provide pedestrian refuge islands between the cycle tracks and transit lanes to shorten crossing distance.

❸ Raise pedestrian crossings to slow traffic speeds and prioritize pedestrians. *See 6.6.7: Traffic Calming Strategies.*

Add landscaping on the side median and along the waterfront or park to improve the pedestrian experience.

Install street furniture, lighting, and other amenities such as water fountains and children's play areas.

Provide services and dedicated spaces for vendors, food stalls, and other establishments along the water's edge.

New York City, USA. A two-way cycle track along the western edge of Prospect Park.

Queens Quay; Toronto, Canada

CASE STUDY

Location: Toronto, Ontario, Canada

Population: 2.6 million
Metro: 5.9 million

Right-of-Way: 34 m

Context: Mixed-Use

Cost: 128.9 million CAD
(90 million USD)

Funding: Public (municipal, provincial, and federal governments)

Max. Speed: 40 km/h on street;
20 km/h on Martin Goodman Trail

Involvement

Public Agencies
Government of Canada, Province of Ontario, City of Toronto, Waterfront Toronto, Toronto Transit Commission, Toronto Hydro, Toronto Water, Enbridge, Bell Canada, Rogers, Cogeco, and Allstream

Citizen Associations
Waterfront Toronto engaged with local residents and businesses throughout the design and construction process.

Designers and Engineers
West 8, DTAH, BA Group Municipal Services, ARUP, MMM Group, and James Urban and Associates

Before

After

Photos: Waterfront Toronto

Overview

The revitalization of Queens Quay is one of the largest coordinated street reconstruction projects in Toronto, transforming 1.7 kilometers of the city's main waterfront street into a showpiece waterfront boulevard.

The roadway was reduced from four lanes of vehicular traffic to two, shifting east-west traffic to the north side of the street. Dedicated turning lanes, sophisticated signal timing, and new loading bays keep traffic flowing along the north side.

Free of vehicular traffic, the south side of Queens Quay became a generous pedestrian promenade with a double row of trees and a new off-street cycle track, filling in a gap on the existing Lake Ontario Waterfront Trail.

The Toronto Transit Corporation's streetcar right-of-way runs along the centre of the street. New north-side sidewalks encourage more retail activity. The project is also a complete rebuild of the street's subsurface infrastructure. New and upgraded municipal storm and sanitary sewers were designed to last a generation.

Waterfront Toronto coordinated with several utility companies and public agencies (Toronto Water, Toronto Transit Corporation) and took advantage of the opportunity to upgrade their infrastructure within the construction zone.

Goals

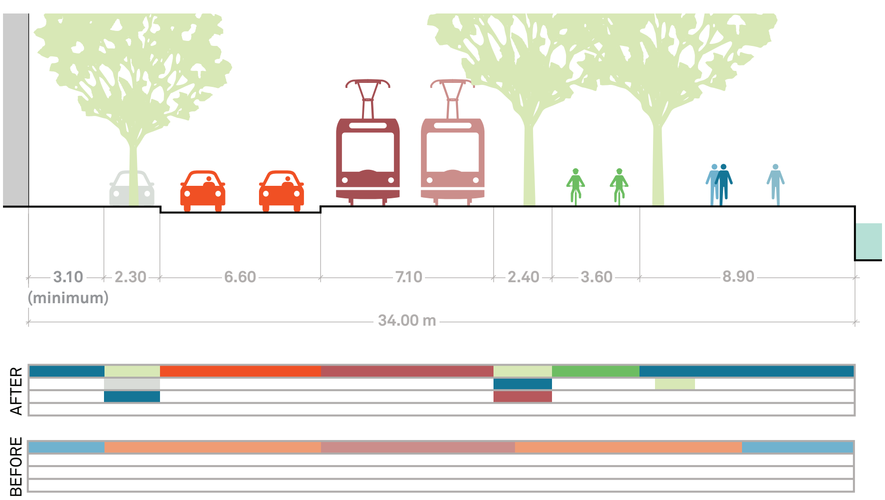
- Rebalance the street, giving each mode of transportation its fair share.
- Create a more welcoming, pleasant main waterfront boulevard with access to the water's edge.
- Attract new business and promote tourism.

Lessons Learned

Public consultation was a hallmark of this project from its very beginning. Waterfront Toronto held almost 100 public meetings and stakeholder-consultation meetings over the course of this project.

As construction on linear projects in dense urban neighborhoods is always difficult, Waterfront Toronto worked closely with stakeholders during construction to keep a two-way line of communication open. This effort included monthly meetings with community representatives and weekly construction notices. Managing the needs and schedules of multiple stakeholders and utilities required an unusually high level of inter-agency coordination.

Protecting landscaping features while still making space for all necessary utilities proved a difficult but worthwhile exercise. When conflicts arose over the location of underground infrastructure and services, Waterfront Toronto developed creative solutions to ensure that both public realm and essential utilities could coexist.



Key Elements

Creation of a pedestrian promenade along the waterfront.

Creation of a two-way, off-street cycle track.

New street furniture installed.

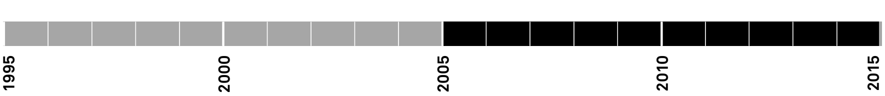
New trees planted.

Taxi and loading bays accommodated.

Widened sidewalks.

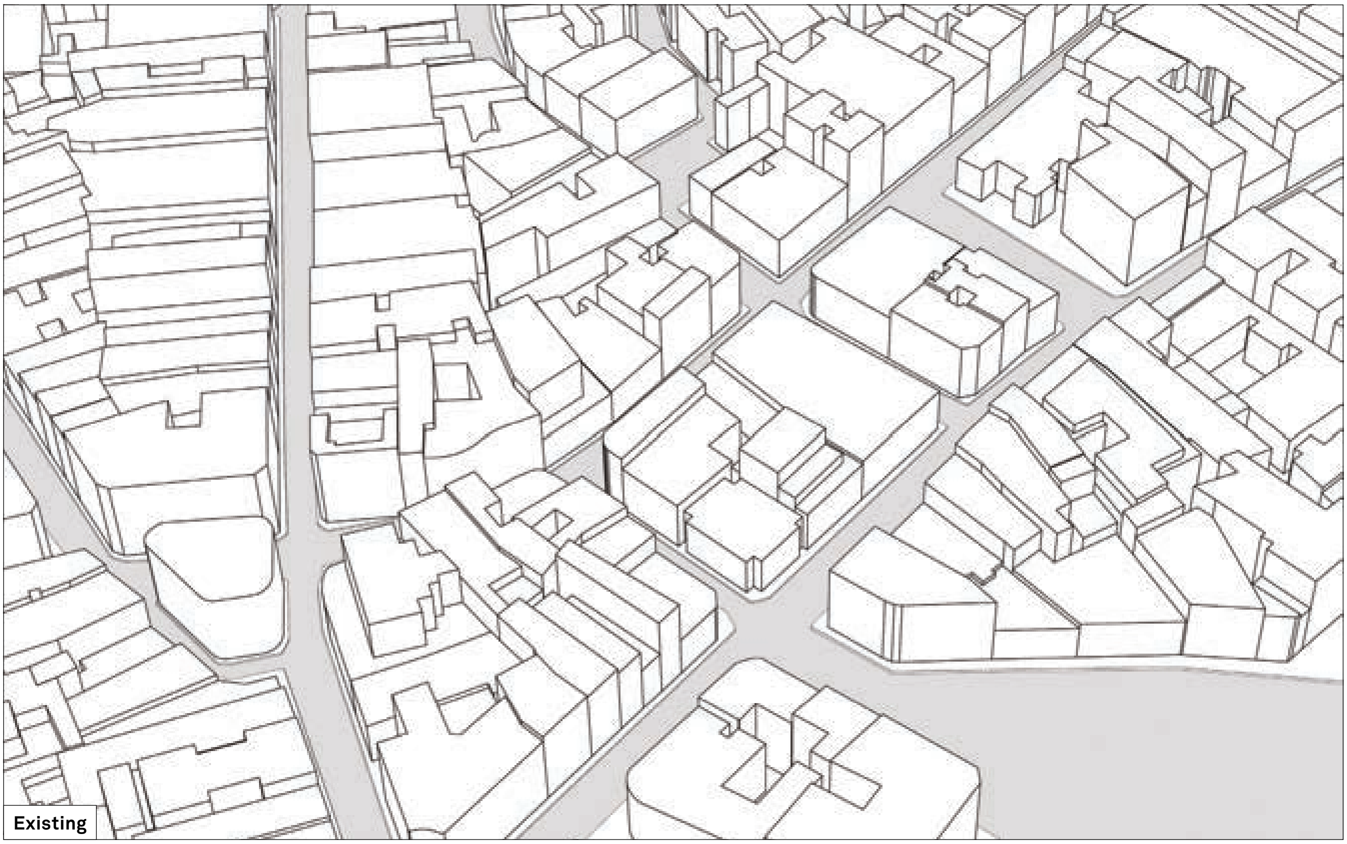
Project Timeline

2005–2015 (Approx. 10 Years)



Users-bar legend:
- Pedestrian space
- Bicycles
- Transit
- Mixed traffic
- Landscape
- Delivery Parking

10.7.7 | Historic Streets | Example



The historic centers of many cities were developed well before the automobile era, and feature narrow streets and lanes that weave among a rich tapestry of buildings. Closing these areas to motorized traffic, permitting limited loading, and transforming them into pedestrian spaces can add significant quality to the neighborhood and the citywide network.

Existing Conditions

The illustration above is a schematic depiction of a network of narrow streets and alleys built before the car era.

The historic significance of such areas can restrict construction and reconstruction permissions.

Access for emergency vehicles and city services such as waste collection can be tight as streets are overrun with private automobiles.

While this network often has rich architecture and active ground floors, stores and businesses may struggle.

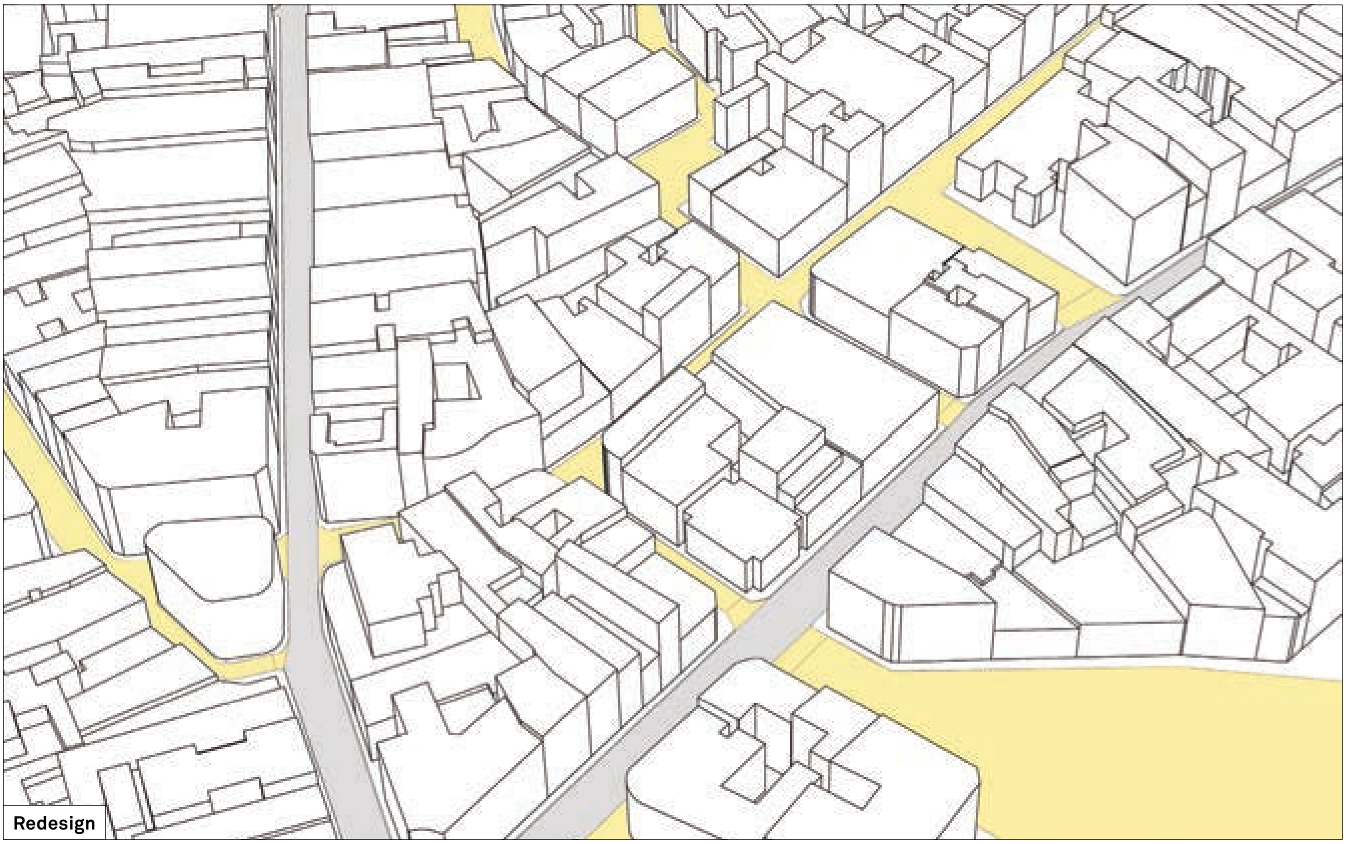
In some cities, exposed utilities such as drains and electric wires are an unavoidable part of the street, raising safety issues for all users.

Design Guidance

Revitalizing urban streets can help to reinvigorate the area and strengthen the historic centers. Create Limited Traffic Zones or pedestrianize selected corridors to restore the original balance and multiple functions of these streets. Work with local residents and businesses to identify areas to remove or limit through-traffic and parking, and prioritize pedestrians, cycling, and transit use. *See 10.3.1: Pedestrian-Only Streets.*

Add distinctive paving, street furniture, signage, and lighting to reinforce the character of the neighborhood.

Implement wayfinding and signage that reflect historical and cultural context and landmarks.



In areas with cobblestones or other uneven surfaces, consider adding narrow strips of pavers that allow for smoother cycle riding.

Limit cycling on streets where pedestrian volumes are high to avoid conflicts.

Pedestrianization should maintain access for emergency vehicles at all times of the day.

Allow automobile access during off-peak times for loading and delivery purposes, or for residents when necessary.

São Paulo, Brazil. The transformation of the main downtown streets into pedestrian areas occurred between 1976 and 1981. At the time, there were about 20 streets in the program, covering approximately 60,000 m. In addition, some sidewalks were extended to 10 m. This new configuration allowed the qualification of everyday uses with shaded seating areas. Today this area is in a process of expansion and redevelopment, with new furniture to accommodate new forms of use.

Historic Peninsula; Istanbul, Turkey

CASE STUDY

Location: Fatih District, Istanbul, Turkey

Population: 14.3 million

Extent: 5,000,000 m

Right-of-way: Various

Context: Mixed-Use (Residential/ Commercial/Institutional) and Historic

Cost: 500,000 EUR—consultation only (approx. 560,000 USD)

Funding: Public

Overview

The Istanbul Metropolitan Municipality began a series of pedestrianization projects in 2005 to increase the quality of life in the historic peninsula.

The Transportation Coordination Center (UKOME), the decision-making body on matters of transportation in the Istanbul Metropolitan Municipality, drafted a number of resolutions for the historic peninsula that aimed to reduce the negative effects of vehicular traffic on tourism, commercial practices, and the environment.

Based on UKOME resolutions and information provided by the 2010 study *Istanbul Public Spaces and Public Life*, the Fatih Municipality prioritized streets for pedestrianization efforts and accelerated infrastructure work. As a result, 295 streets in the peninsula have been pedestrianized and supporting infrastructure projects such as traffic signalization, granite paving, and waste-management improvements were completed.

Before

After

Photo: Embarq Turkey

Key Elements

Pedestrians can walk on the entire right-of-way.

Quality paving materials and textures.

Progressive removal of obstacles, curbs, and bollards.

Goals

- Drastically reduce air pollution in the historic center.
- Provide more pedestrian-friendly spaces for residents, visitors, and business owners.
- Provide a high-quality and attractive environment.
- Create a space that supports local businesses.

Lessons Learned

The main challenges to implementation were difficulties in interagency coordination, particularly between ministries, and opposition from local business owners. Many feared that the pedestrianization would negatively impact their businesses.

Involvement

Public Agencies
Istanbul Metropolitan Municipality, UKOME, Fatih Municipality (leads)

Private Group and Partnerships
Upper Laleli Industrial Association

Nonprofits
EMBARQ Turkey (lead), Mimar Sisan Fine Arts University

Designers and Engineers
Gehl Architects

Evaluation

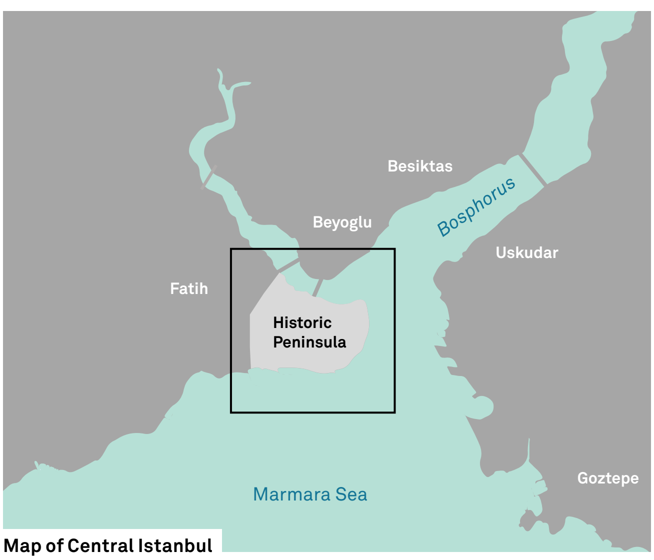
80%
Overall satisfaction

+68%
Increased street safety for pedestrians according to residents

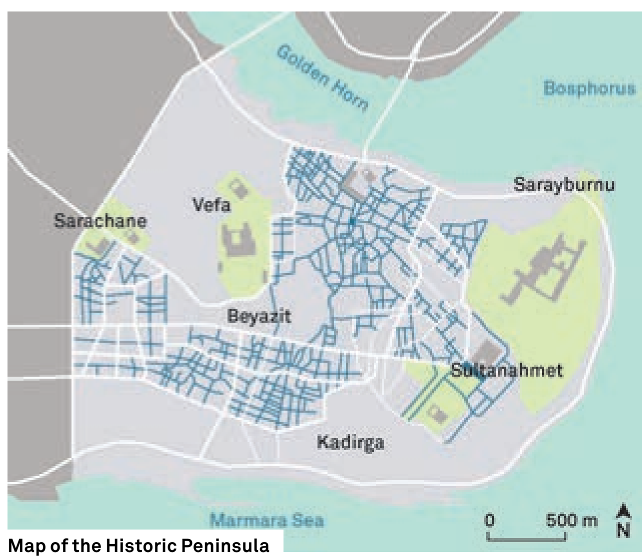
+83%
Increased walkability according to business owners

-80%
Decrease in SO_2 levels

-42%
Decrease in NO_2 levels



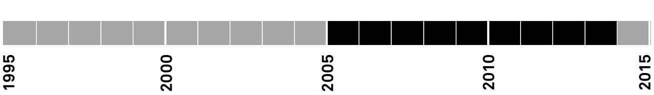
Map of Central Istanbul



Map of the Historic Peninsula

Project Timeline

2005–2014 (Approx. 9 Years)



Between 2005 and 2009, four squares and nearby streets were pedestrianized. In 2010, a site management project for tourist buses, parking area rearrangement, and a shuttle route project were completed. In 2010, Sultanahmet Square and nearby streets were pedestrianized. Between 2011 and 2012, 250 streets pedestrianized. In 2013, 45 streets were pedestrianized.

10.8
Streets in Informal Areas

Informal urban areas form a large portion of the built fabric in many cities around the world. They often emerge in response to urban migration and the inability of cities to absorb population growth or provide affordable housing and adequate services within a planned urban framework.

While informal settlements are integral to the overall economy and livelihood of many cities, they are often spatially segregated and disconnected due to the absence of infrastructure. A lack of streets and open spaces that connect them to their surroundings can make the provision of basic services almost impossible.

As people continue to move to urban areas in search of jobs, there will be opportunities to ensure that the design of streets in new and existing settlements becomes a means for promoting strong, safe communities. Work with local communities on strategies to invest in the provision of local utilities, safe environments for walking and cycling, and increased public access and emergency services. The street can play a critical role in providing services for residents of informal neighborhoods, while minimizing displacement and improving overall connectivity and quality of life.

Addis Ababa, Ethiopia

10.8.1 | Overview

The overall percentage of land allocated to streets in informal areas is roughly 5%, which is much less than the 30% recommended by UN habitat.[15]

Informal settlements are typically overcrowded and information about their street networks and hierarchies may not be available. While bustling with life, this settlement may suffer from unsafe and unsanitary living conditions. Access to facilities for water, power, and sanitation, typically provided within a planned right-of-way, do not exist, and infrastructure to support safe movement is lacking.

To provide basic services to their residents, these settlements require well-connected and maintained streets. They must prioritize streets as the basic element of mobility and accessibility, and use them for the provision of services. This can support economic development and contribute to a higher quality of life.[16]

10.8.2 | Existing Conditions

Mode Share

Walking and cycling are often the most used modes of transportation. These accessible and affordable means can be a burden over long distances and hazardous if there is no infrastructure to support them. Car ownership is steadily increasing but is still very low, and motorized two-wheelers or small collective transport tend to dominate.

Safety

Residents may walk long distances to work or school. Access to water and other services are provided along roads that prioritize motorized transport and lack sidewalks or cycle lanes. The perceptions of safety are poor, and the risk of being hit by moving vehicles is high.

Public Utilities

Basic utilities such as water, power, waste, and sanitation may not be present in informal streets. Informal systems may be developed at a high cost to residents, and are often inadequately managed.

Emergency Vehicular Access

Narrow street networks make access for emergency vehicles very difficult. Identify core corridors that might be widened and paved, in order to improve access for emergency vehicles. Acceptable dimensions between emergency vehicle access points should be determined at the network level. Local authorities may use special emergency vehicles such as mini vans or motorized two-and three-wheelers to disseminate services in narrower streets and neighborhoods.

Collective Transport Access

As many informal areas are settled on the outskirts of cities, reliable transport options to access jobs and services can be extremely limited. Collective transport is often informally organized, privately managed, and operated with small minivans, taxis, and motorcycles. This results in many residents spending a very high proportion of their income on commuting. Topography can be a major barrier in some cases.[17]

Quality of the Built Environment

Streets may be relatively narrow and often unpaved, turning into corridors of mud after heavy rains, which makes walking and cycling challenging and hazardous. Even in well-connected street networks, poor-quality surfaces render streets inaccessible for people with disabilities.

10.8.3 | Recommendations

Prioritize Non-Motorized Transport Modes

Provide safe pedestrian and cycle infrastructure by building sidewalks and cycle lanes that are continuous and paved, well-lit, and well-maintained. Where streets are too narrow to provide accessible sidewalks, shared streets should be designed to ensure equitable access to people of all abilities. When these are paved, motorists feel invited to travel faster. Implement traffic calming measures to ensure all users remain aware of each other and to proactively shape cultural mobility habits where car ownership is low. *See 6.3: Designing for Pedestrians; 6.4: Designing for Cyclists.*

Integrate Transport with Mixed-Use Planning

Prioritize investment in infrastructure and transport where growth is occurring. Ensure that jobs, schools, health centers, commercial activity, and other community facilities are provided in growth areas and are accessible via collective transport. *See 5: Designing Streets for Place.*

Increase Network Connectivity

Work with local communities to determine the best routes to develop a street hierarchy and key destinations that improve access to public utilities and emergency services. Strategic widening on certain corridors should help local businesses grow and maintain the pedestrian character of streets. Displacement should be minimized and well compensated, offering relocations within the same area. Document, map, and communicate the street network to local residents and service providers to ensure all stakeholders are aligned.





Medellín, Colombia. New streets, paths, and circulation infrastructure in Comuna 13 improve the quality of public space and access for the local community.

Provide Drainage

Streets should be designed to move, retain, and transfer water to larger connected systems. Standing water and open sewers cause serious health hazards and are extremely dangerous on streets with narrow rights-of-way.

Informal spaces, especially when lying in hilly areas, should take advantage of the contextual hydrology and topography for laying out drainage and water-supply systems to minimize costs. Provision for trunk infrastructure should be coordinated with street designs.

Ensure Lighting

Ensure that pedestrian spaces are well lit, avoiding dark spots by placing lights at close, regular intervals. Where power supply is not reliable, consider renewable technologies for energy generation. *See 7.3.1: Lighting Design Guidance.*

Basic Utilities and Services

Develop a strategy to include basic public utilities within the public right-of-way. Street design and access can improve waste collection, recycling, and waste management. Service and emergency vehicles should be accommodated on strategic routes. Drains and openings should be covered and made safe for pedestrians and cyclists. *See 7: Utilities and Infrastructure.*

Facilitate Navigation and Wayfinding

It is important to adopt wayfinding and street name systems and signage to ease navigation through these neighborhoods for residents, visitors, and emergency services. *See 6.3.9: Wayfinding.*

Enhance Collective Transport

Consider options for new collective transport systems to access informal settlements, whether bus, BRT, light rail, or metro. In particularly steep hillside communities, consider aerial lifts or escalators for improved access. Collective transport service must be a reliable, affordable, safe, and efficient alternative to car ownership.

Allow Movement of Goods

Consider the delivery of goods by vehicle to strategic distribution points within the street network, supplemented by a system of smaller carts, vehicles, or carriers that allow the transfer to local homes or businesses. *See 6.7: Designing for Freight and Service Operators.*

Calle 107; Medellín, Colombia

CASE STUDY

Location: Andalucia neighborhood, Medellín, Colombia

Population: 2.4 million
Metro: 3.7 million

Context: Residential (Informal Settlement)

Right-of-way: 19 m

Extent: approx. 1 km

Cost: 3.2 billion COP (1.1 million USD)

Funding: Public

Max. Speed: 30 km/h

Before

After

Photos: Empresa de Desarrollo Urbano

Overview

The Calle 107 urban promenade is a 19-m wide street, located between the Medellín river and the Andalucía station of the Metrocable in Medellín. The street plays an important commercial role and serves as a gathering place for residents. In recent years, the street experienced an increase in commercial activity.

The street design project includes a pedestrian promenade, improvements to existing public spaces, and a new park. The redesign aims to strengthen the role of the street by recognizing its nature as a pedestrian axis and by strengthening the businesses located along it.

Taking into consideration a series of requests from the residents, the city of Medellín decided to upgrade the street. In its southern stretch, the street has been partially converted into an urban promenade. This includes the creation of a large sidewalk paved with quality materials in order to make the promenade more visually recognizable.

In addition, the Urban Development Agency negotiated with the landlord of the properties adjacent to the street to use similar treatments to building frontage areas to maintain a consistent and recognizable urban design identity.

Calle 107 was transformed from a car-oriented road to a mixed and pedestrian-friendly street, stimulating commercial development.

Goals

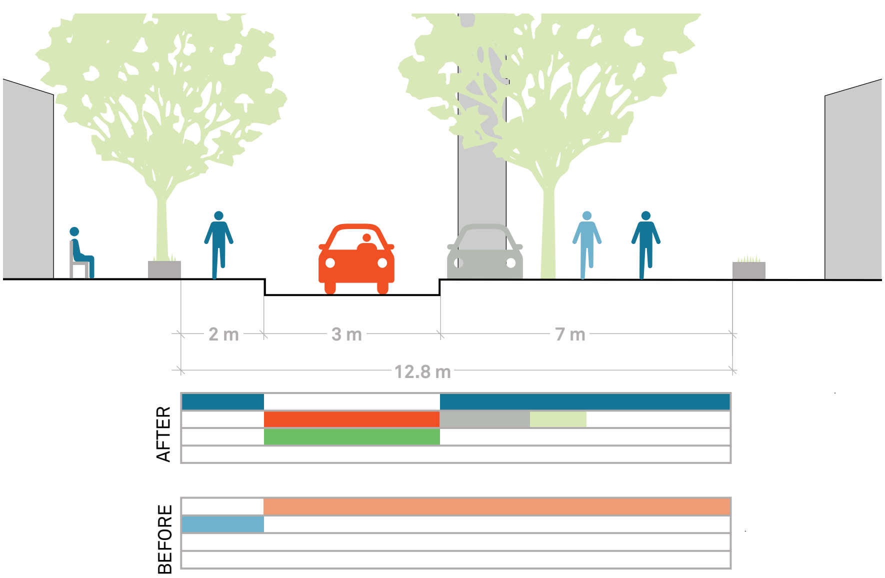
- Create a clear distinction between public and private space.
- Provide places for play and relaxation.
- Create a safe, well-lit, and easily surveyed pedestrian route.
- Employ sustainable landscape practices.
- Use easy-to-maintain and durable designs and materials.

Involvement

Public Agencies
Municipality of Medellín, Empresa de Desarrollo Urbano (EDU), Department of Transportation, Department of City Planning

Citizen Associations and Unions
The community of Andalucía

Designers and Engineers
Empresa de Desarrollo Urbano (EDU)



Key Elements

High-quality, durable materials that are locally sourced.

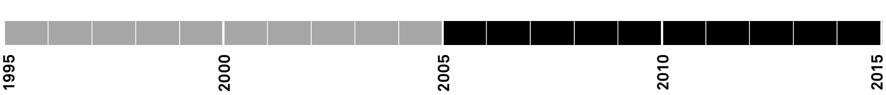
Tree planting and porous surfaces.

High-quality lighting.

Wide, continuous sidewalks.

Project Timeline

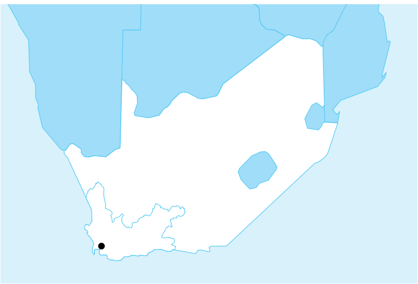
2005–2015 (Approx. 10 Years)



Users-bar legend:
- Pedestrian Space
- Cycles
- Transit
- Mixed Traffic
- Landscape
- Delivery Parking

Khayelitsha; Cape Town, South Africa

CASE STUDY



Location: Khayelitsha, Cape Town, South Africa

Population: 0.4 million
Metro: 3.7 million

Context: Low-Income Settlement (formal and informal)

Right-of-way: Various

Area: 28,000 m²

Cost: 20 million ZAR (1.45 million USD) Includes safe walkways, lighting, urban park, active box

Funding: German Development Bank (KfW)

Max. Speed: N/A

Overview

The project is part of the Violence Prevention through Urban Upgrading (VPUU) program, which aims to address four types of exclusion (economic, cultural, social, and institutional) in low-income settlements in an effort to prevent crime.

The project was one of the first VPUU Safe Node Areas that responded to local residents' needs to overcome high levels of crime along a primary pedestrian route, a shortcut connecting the informal settlement of Monwabisi to the local train station and schools.

The project aimed to create a series of landmark nodes with safe connectivity.

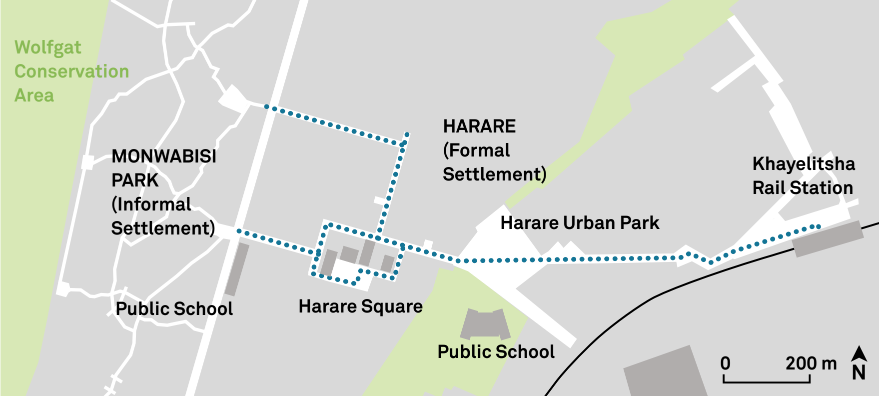
The pedestrian link connected an urban park that was previously identified by community members as one of the most unsafe areas of the neighborhood.

The Khayelitsha area now enjoys a dynamic urban park, a safe pedestrian walkway, and a public square with a series of public amenities and active boxes.

Before

After

Photo: VPUU NPC



Map of the Khayelitsha area

Goals

- Provide a clear definition between public and private spaces.
- Provide places for play and relaxation.
- Create a safe, well-lit, and easily surveyed pedestrian route.
- Employ sustainable landscape practices.
- Use easy-to-maintain, durable materials and designs.

Lessons Learned

Through participatory design and development with local leadership and the relevant municipal departments, the professional team was able to transform a high-crime area into a sustainable, multifunctional public space.

Keys to Success

Community participation in the design and implementation phases in Khayelitsha facilitated the development of designs for various components of the spaces. This enabled community participation, skills transfer, and ongoing work opportunities in the maintenance of the public spaces.

Local pride, involvement, and stewardship have been fundamental in reducing vandalism and urban violence, transforming the use and perception of the space.

Residents volunteered as security groups and participated in maintenance efforts. Many activities take place today in the new public space, which increases the eyes on the street and supports a sense of safety.

Involvement

Public Agencies
City of Cape Town, South African National Treasury, Federal German Ministry for Economic Cooperation and Development, German Development Bank (KfW)

Citizen Associations and Nonprofits
The community of Khayelitsha, Khayelitsha Development Forum (KDF), VPUU NPC, Grassroots Soccer, Mosaic

Designers and Engineers
AHT Group AG/SUN Development Team, Tarna Klitzner Landscape Architects (TKLA), Jonker & Barnes Architects, Naylor Naylor Van Schalwyk, Talani, N2 Construction, and Ross Engineering

Photo: VPUU NPC

Key Elements

High-quality, long-lasting materials that are locally available.

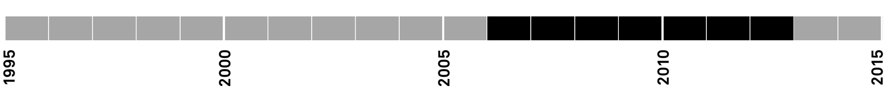
Tree planting.

Porous surfaces.

High-quality lighting.

Project Timeline

2006–2013 (Approx. 7 Years)



Evaluation

+30%

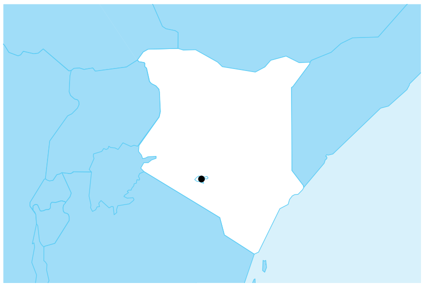
Increase in pedestrian activity

-45%

Decrease in the murder rate between 2006 and 2014 in the Safe Area Node

Street of Korogocho; Nairobi, Kenya

CASE STUDY



Location: Korogocho, Nairobi, Kenya

Population: 3.7 million

Area: 0.89 km

Right-of-Way: Various

Context: Residential (Informal Settlement)

Cost: 210 million KES (approx. 2 million USD)

Funding: Kenya-Italy Debt for Development Programme (KIDDP), Government of Italy through the Italian Development Cooperation, and the Government of Kenya

Overview

Korogocho is Nairobi's fourth-largest informal settlement. Settlement began in the 1970s by quarry workers and first underwent redevelopment in 1987. Since then, the streets have been appropriated for various uses and have become narrower over time.

The Street Upgrading Project is part of a larger program called Korogocho Slum Upgrading Program (KSUP). To address the key issues of poor access roads, bad drainage, inadequate streetlights, and poor water and sewage systems, the KSUP planning process aimed to use integrated participatory planning steps as a resilient slum-upgrading method.

The project helped promote microeconomic activity, increase the number of jobs, and improve the perception of safety. The redesigned streets provided a greater number of public meeting places and improved connectivity to the larger urban fabric.

Before

After

Photos: UN Habitat

Goals

- Establish residents' confidence in the upgrading program.
- Improve physical, economic, and social living conditions through participatory planning and management.
- Increase microeconomic activity, safety and security, and mobility for residents.
- Invoke a sense of pride among the residents.
- Facilitate planning and security of tenure provision.
- Develop security through increased business opportunities and street lighting.

Lessons Learned

The level of participation highly affects residents' attachment to the streets. Communication is crucial to raise awareness of the changes carried out by the project.

Engage with the residents in the upgrading process to ensure social sustainability in these areas.

The safety of a street has many dimensions. Design streets to accommodate all users and discourage criminal activities.

Create streets to accommodate all modes of transportation.

Maintain the street's role as a vibrant public meeting space.

Design streets to be flexible and satisfy various community needs. Provide temporary structures as well as permanent ones.

Consider waste management, cleaning, and repairing of the streets in slum settlements.

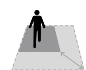
Involvement

Public Agencies
Ministries of Local Government, Housing, Lands and Finance; City, County, and Province of Nairobi; Italian Government

Citizen Associations and Nonprofits
Korogocho Residents Committee, UN Habitat, Comboni missionaries

Designers and Engineers
The Nairobi City Council and the Ministry of Local Government

Evaluation

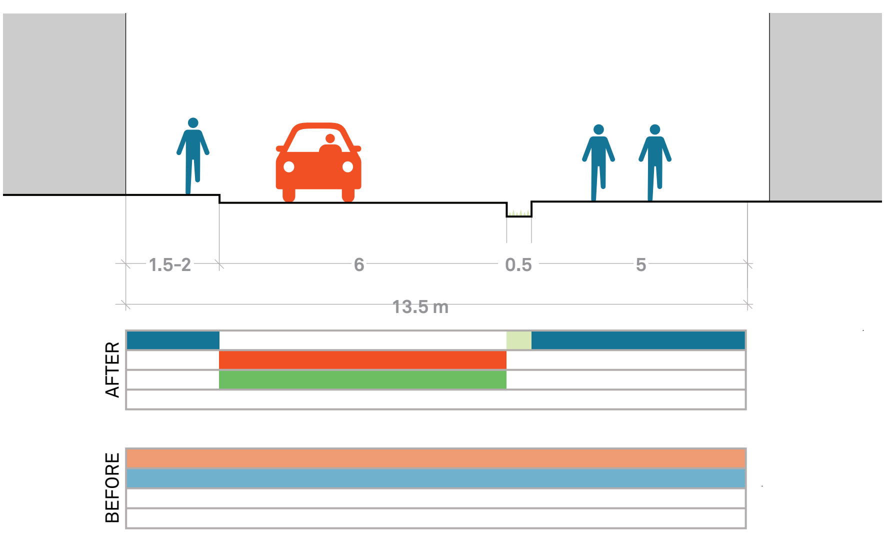


+20%

Increase in open space

Residents reported:

- An increase in new activities
- An increase in pedestrian volumes
- An increased number of vendors and business activities
- An increase in the perception of safety



Key Elements

Streets were prioritized on the basis that they ensured circulation in all eight villages.

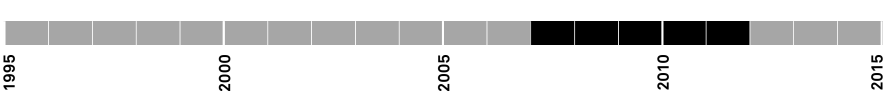
Reclaimed public space, reverting street widths back to those established in the 1987 upgrading.

New connections to surrounding urban fabric.

Increased access and basic services (drainage, water, sewerage, and street lighting).

Project Timeline

2007–2012 (Approx. 5 Years)



Users-bar legend:
- Pedestrian space
- Cycles
- Transit
- Mixed traffic
- Landscape
- Delivery Parking


ELECTRICITY HOUSE

11

Intersections

Intersections are where demands of different street users come together. They are key focal points of activity and decision making, requiring all users to face, manage, and maneuver around each other.

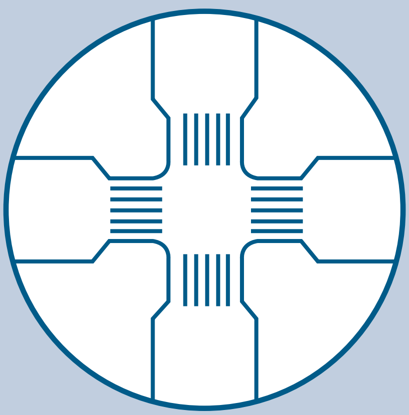
Intersections vary in configuration, type, and size, and they play a key role in shaping the overall safety, legibility, and efficiency of a city's street network. Since most conflicts occur at intersections, careful redesign presents opportunities to reduce crashes and fatalities. Good intersection design can also tap civic and economic potential, infusing overbuilt or underutilized spaces with street activity.

Intersection design should facilitate visibility and predictability for all users, creating an environment in which complex movements feel safe, easy, and intuitive. This chapter discusses overall intersection design principles and provides examples of intersection typologies based on scale and complexity, while referencing design elements discussed in previous chapters.

Accra, Ghana

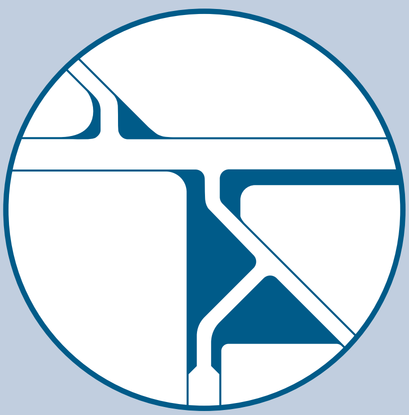
11.1 | Intersection Design Strategies

Design intersections to promote eye contact between all street users to increase awareness and to support active interactions. The following strategies help to reduce conflict and ensure safe spaces for all users. Use them to support the key principles outlined in Chapter 4: Designing Streets for Great Cities.



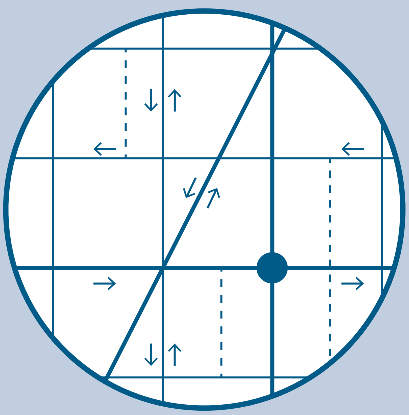
Design Compact Intersections

Break large intersections into a series of smaller intersections. Compact intersections reduce exposure, slow traffic near conflict points, and increase visibility. Tighten turn radii, remove slip lanes, and limit turn lanes when possible. *See 6.6.4: Travel Lanes, 6.6.5: Corner Radii, and 9.2 Design Vehicle and Control Vehicle.*



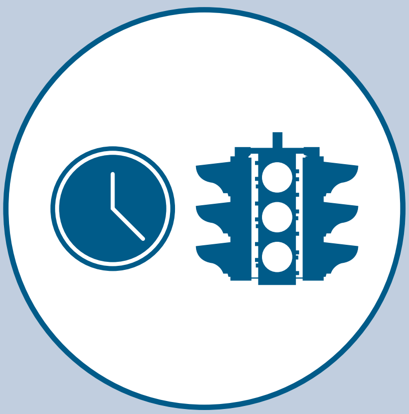
Simplify Geometry

Simplify geometry of complex intersections to increase legibility, uniformity, and safety. Align geometry of opposite legs of an intersection and daylight intersection corners to improve sight lines and visibility. *See 6.6.6: Visibility and Sight Distance.*



Analyze Networks

Intersections should not be observed in isolation but as part of larger environments and networks. Solutions for capacity or volumes may be found at the corridor or network level. Make trade-offs between the intersection and the network in terms of traffic volume and capacity. *See 8.4: Network Management and 8.5: Volume and Access Management.*



Integrate Time and Space

Reconfigure intersections through signalization as an alternative to widening them, to address delay or congestion. This helps in reducing speeds between junctions, prioritizing transit, and increasing safety. Include transit-priority, pedestrian, and cycles leading intervals, and manage left turns with dedicated signal phases. *See 8.8: Signs and Signals.*

Increase Pedestrian Space

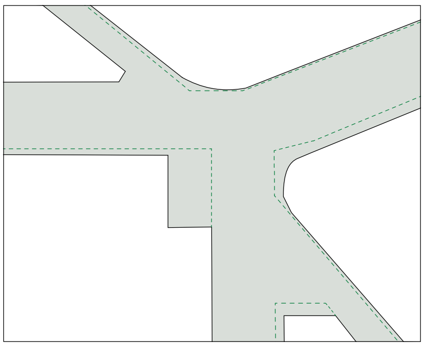
Increase pedestrian space while redesigning intersection geometry, consolidating spaces in logical and usable areas. Use interim plazas and low-cost elements and materials to quickly enhance public life and reduce safety concerns. *See 6.3.7: Sidewalk Extensions and 10.3: Pedestrian-Priority Spaces.*

Start with Vulnerable Users

Design safe infrastructure at intersections by starting with the needs of the most vulnerable users. Use existing pedestrian behaviors and desire lines to guide design. Provide safe and accessible sidewalks, crossings, and refuge areas for pedestrians, and dedicated facilities and protected intersections for cyclists. Reduce vehicle speed by including traffic calming strategies. *See 6: Designing Streets for People and 8.7: Speed Management.*

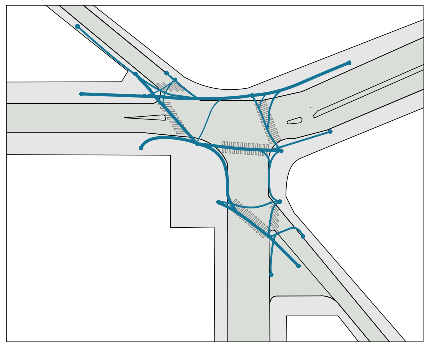
11.2 | Intersection Analysis

The following design process takes a sample complex intersection and details how to understand its existing function, analyze movement, identify opportunities, and create a new design. Driving this process is the underlying need to let land use, community desires, and usage determine solutions.



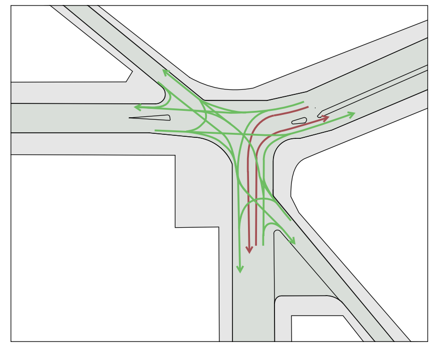
Context

Understand the context within which the intersection functions. Analyze its urban design qualities and document specific gathering places, landmarks, transit stations, and other drivers of activity. Engage the public in this process, allowing safety concerns and community visions to drive the ultimate redesign.



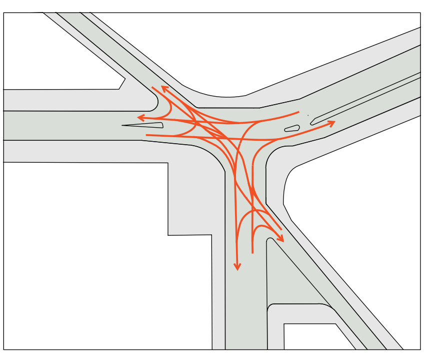
Pedestrian Activity

Document how pedestrians use and activate the intersection as a public space. Where are people gathering, sitting, and talking? What activities are they engaged in? Which public spaces attract people and which do not? Where do people actually cross the street? In urban locations with continual activity, this step can often be accomplished by 15–30 minutes of observation.



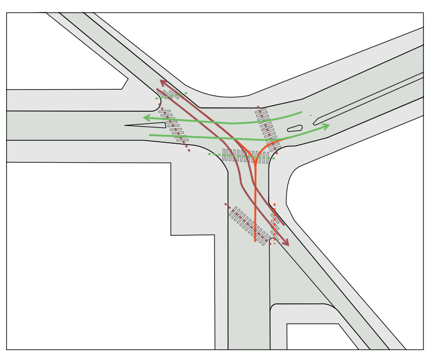
Transit and Cycle Activity

Assess the volume and movement of cyclists as part of the planned and existing cycling network. Document bus headways and volumes, as well as the placement and location of bus stops and other transit facilities. Make note of all other modes of collective transport, their boarding and alighting locations, and facilities.



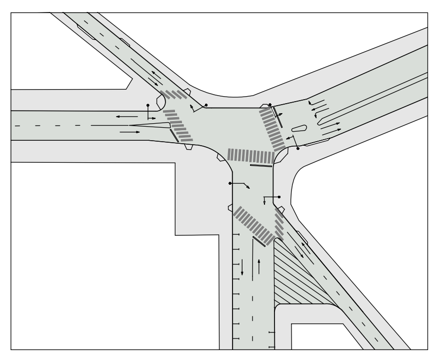
Vehicle Volumes

Map vehicle movements and turns to understand how motorists use the intersection. Overlay volume data to illustrate the relative importance of each movement, looking for low-volume turning movements, in particular. Pair this with observation and understanding of the local planning context and how the street fits into the overall traffic network.



Signalization

Plot the signal phases to show how the intersection flows. Obtain phasing data from the appropriate agency, or create a general timing plan, ascertained with a stopwatch. Note whether pedestrian and vehicle signals are fixed or actuated. Observe how well the phases match volumes, how people comply, and when signals give priority to drivers, cyclists, or pedestrians.



Geometry, Signals, Signs, and Markings

Survey the intersection's dynamic conditions, or how people are meant to move through the junction based upon existing markings and geometry.

11.3 | Intersection Redesign

Based on the intersection analysis, this intersection is redesigned to provide a legible, safe, and comfortable space for all users.

Design Compact Intersections

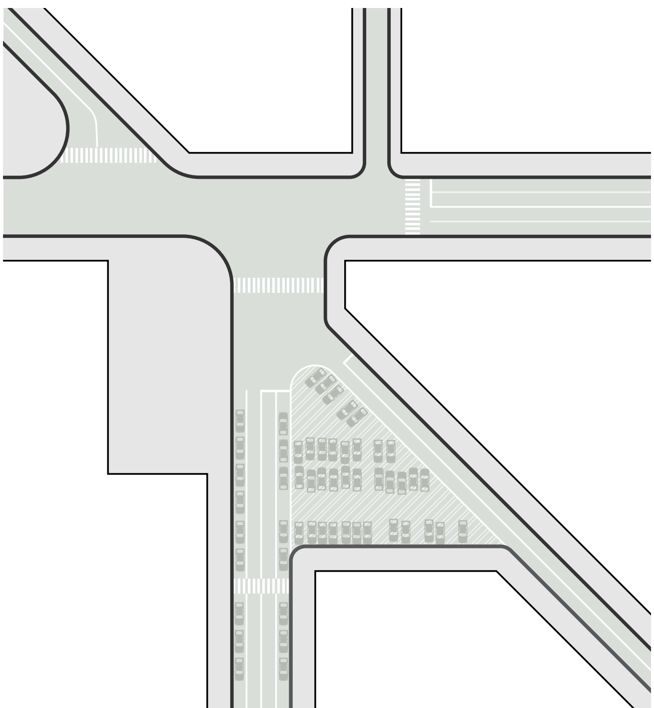
- Break complex intersections into multiple, compact ones.
- Minimize intersection size through the addition of curb extensions, plazas, and medians. Minimize vehicle turning speeds using medians, realignment, and small corner radii.

Simplify Geometry

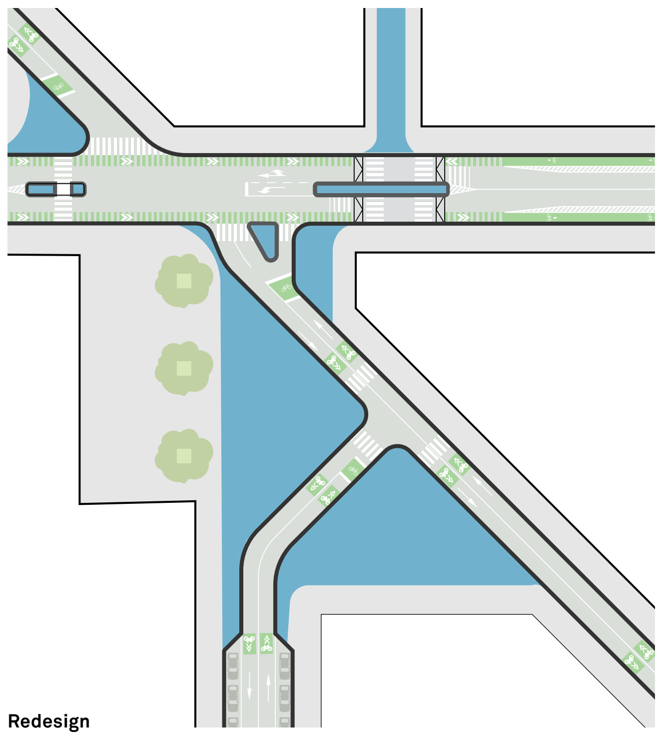
- Bend streets so that they meet at as close to a 90-degree angle as possible.
- Maintain view corridors and sight lines for legibility and wayfinding.
- Align crossings with pedestrian desire lines and key destinations.

Analyze Networks

- Where traffic volume data reveals excess vehicle capacity, reduce the number of lanes along a corridor, consolidate excess turn lanes, and eliminate slip lanes.
- Reallocate space to medians, cycle infrastructure, or sidewalks.
- Integrate intersection design elements with the surrounding buildings and plazas.



Existing



Redesign

Integrate Time and Space

- Restricting vehicle turns at acute-angled intersections with very low volumes saves signal time and improves safety. Provide curb extensions and medians.
- Align stop lines at all legs of the intersection to be perpendicular to the travel lanes, enhancing overall clarity and visibility for both vehicles and pedestrians.

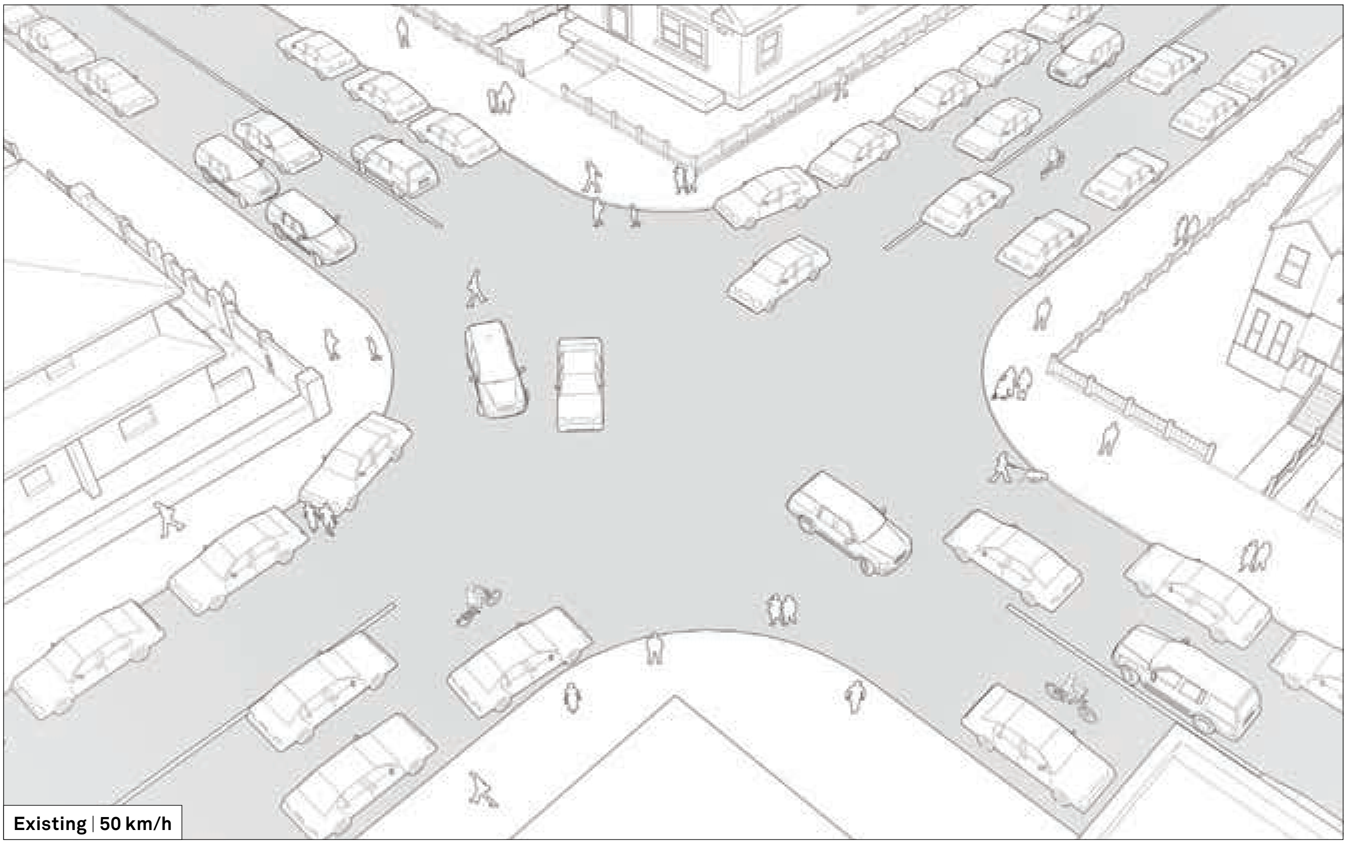
Increase Pedestrian Space

- Reallocate space for pedestrians and cyclists. Widen narrow sidewalks and add cycle facilities.
- Assess and design the entire public realm in a holistic way to create one seamless pedestrian realm.
- Introduce transit stops and other facilities at appropriate locations.

Start with Vulnerable Users

- Realign pedestrian crossings to meet the pedestrian desire lines.
- Add pedestrian ramps and refuge areas at crossings.
- Reduce vehicle speeds through tighter turning radii and narrower travel lanes.
- Provide dedicated space for cyclists.

11.4 | Mini Roundabout | Example



Existing | 50 km/h

Minor intersections in neighborhood contexts where small-scale residential streets meet each other should reinforce vehicles traveling at low speeds. These intersections should be redesigned to invite safe use and easy crossing for all users, including children walking to school and senior residents living their daily routines.

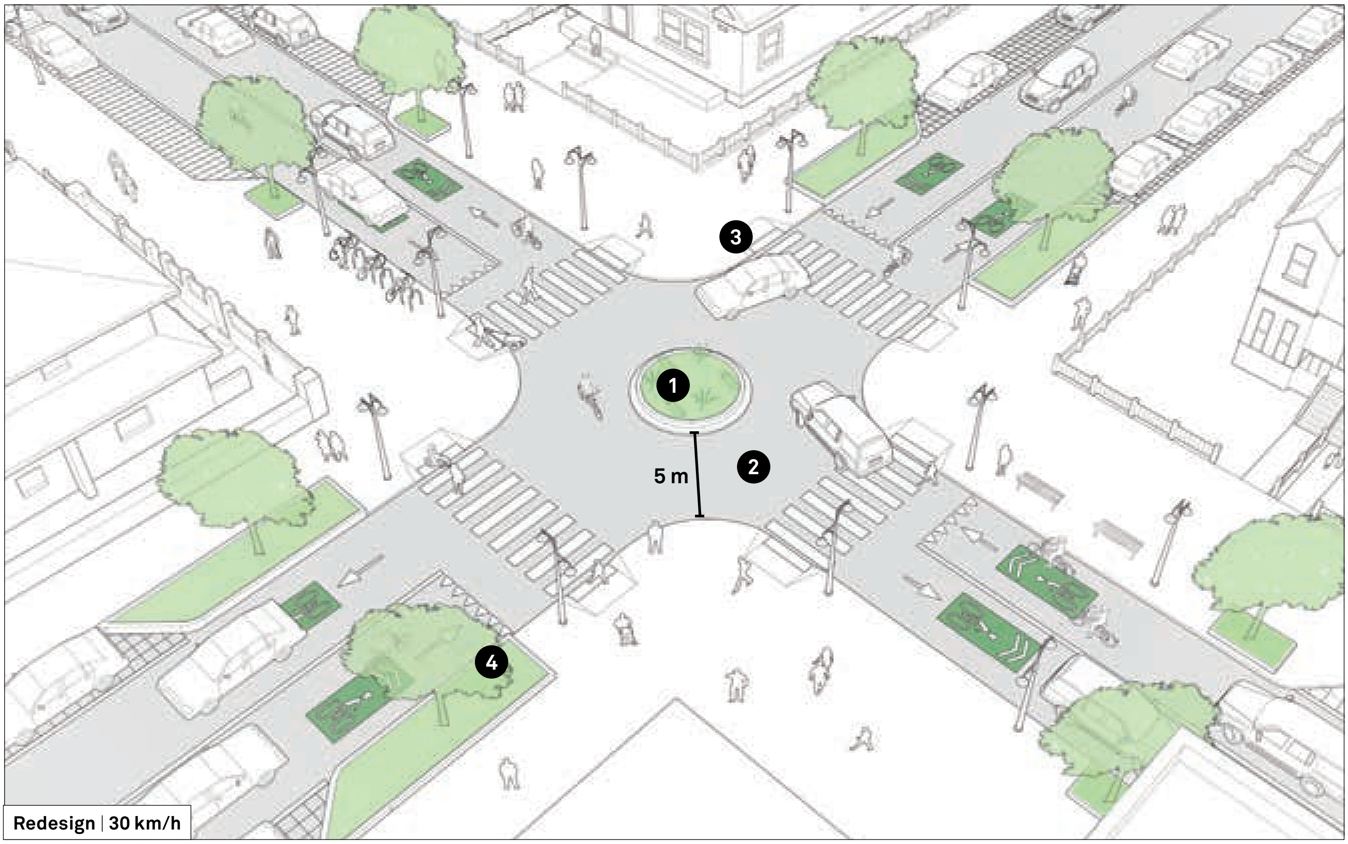
Existing Conditions

The illustration above depicts an intersection of two one-way streets, each with two travel lanes. The allocation of space in this intersection is unbalanced as these streets have very low traffic volumes but vehicles have most of the space. Parking is unregulated and vehicles are parked near the intersection corners.

Large corner radii create a dangerous condition due to vehicles turning at high speeds and conflicting with pedestrian movement.

A lack of marking at the intersection creates uncertainty about the space dedicated to each user.

Bandung, Indonesia.



Design Guidance

Mini roundabouts are an ideal treatment for unsignalized intersections of small-scale streets. They have been shown to increase safety at intersections, reducing vehicle speeds and minimizing the points of conflict.

In this type of intersection, motorists must yield to pedestrians and vehicles already in the intersection. Pedestrian crossings should be marked to clarify where pedestrians should cross and that they have priority.

1. Install mini roundabouts using simple markings or raised islands. Apply them in conjunction with plantings or small trees, which enhance the traffic calming effect and beautify the street.

2. Provide a clearance of approximately **5 m** from the corner to the widest point in the roundabout. A clearance of less than **5 m** is possible by providing mountable curbs on the edge of the roundabout.

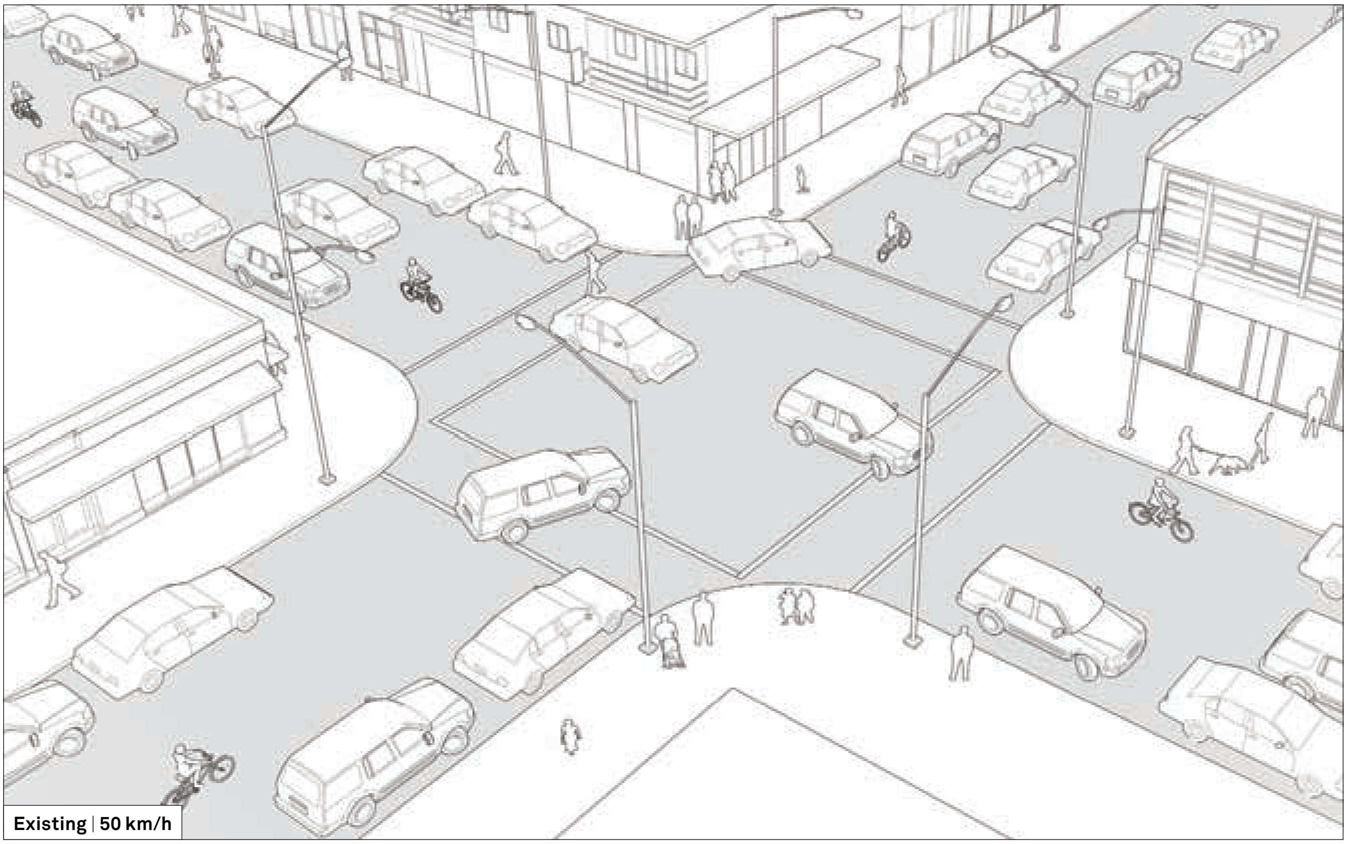
When pedestrian volumes are high, consider raised crosswalks to further reduce vehicle speeds.

3. Add curb extensions to shorten the crossing distance, protect pedestrians waiting to cross, daylight the intersection, and prevent dangerous illegal parking close to the intersection corners.

4. Plant trees, and add bioswales and rain gardens on curb extensions and widened sidewalks.

Austin, USA. A mountable curb in a neighborhood roundabout allows larger vehicles to navigate the intersection when required, while calming everyday traffic.

11.5 | Small Raised Intersection | Example



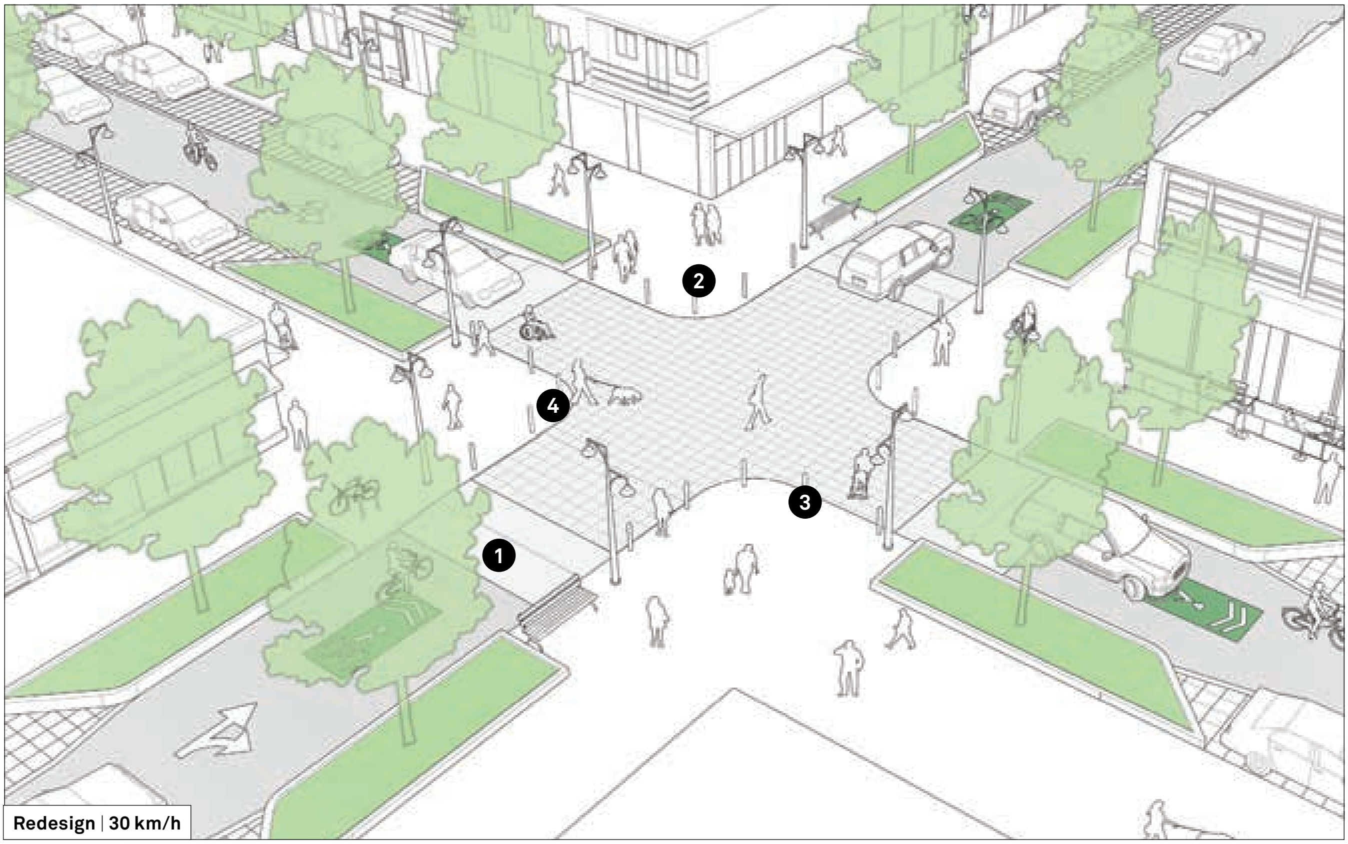
Existing Conditions

An intersection of two one-way streets, each with one travel lane and unregulated parking on both sides.

Large corner radii encourage drivers to turn at high speeds, conflicting with pedestrian movement. Vehicles parked too close to the intersection reduce mutual visibility between motorists and pedestrians.

Sidewalks contain obstacles and lack shade and street furniture. Pedestrian crossings have minimum markings and do not provide accessibility ramps for universal access.

Singapore, Singapore



Design Guidance

1 Raise the intersections to create a safe, slow-speed intersection. Provide speed humps and other vertical defection elements to reduce speeds and signal to motorists that they must yield to pedestrians.

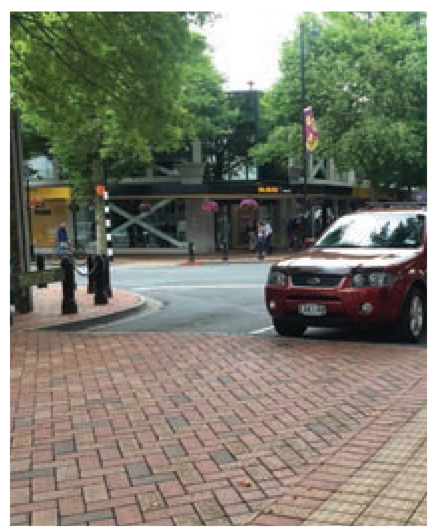
2 Add curb extensions to increase the pedestrian space, reduce the crossing distance, and prevent parking at the intersection corners. Use the extension of these spaces to also provide landscaping and street furniture.

3 Where illegal parking on the sidewalks is a common problem, consider using bollards or street furniture to prevent vehicles from invading the pedestrian space.

4 Where vehicles are not turning, design corners with the smallest constructible radius, approximately **0.6 m.**

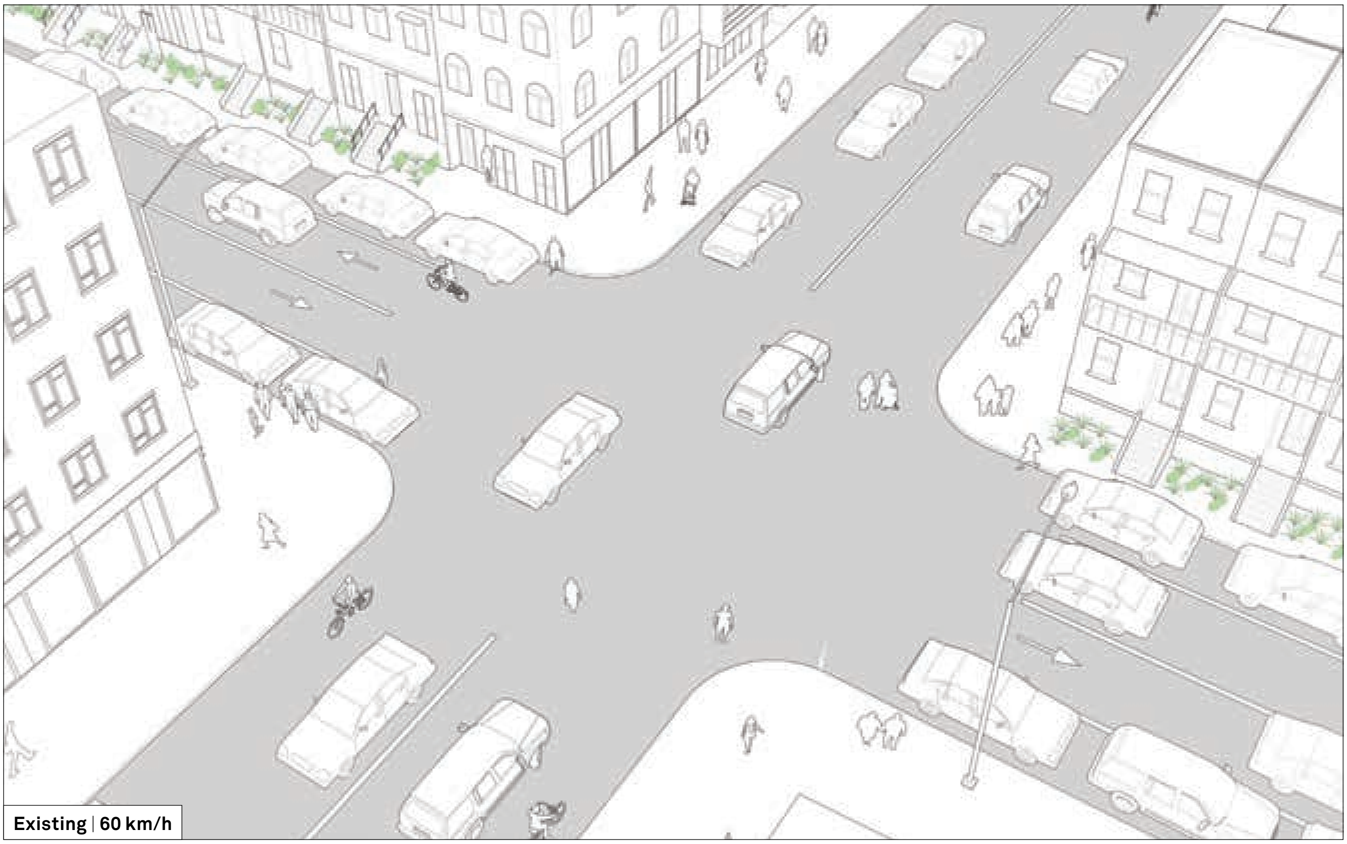
Prioritize cycle traffic on low-speed corridors by treating them as cycle streets with shared lane markings.

Consider removing one lane of parking to create a contraflow cycle lane. Raised intersections increase safety for cyclists riding contraflow and for performing turns across oncoming traffic.



Nelson, New Zealand

11.6 | Neighborhood Gateway Intersection | Example



Existing | 60 km/h

Intersections of streets of different scales often lack the same level of definition, safety, and clarity as same-scale intersections. Where narrow streets meet larger streets, define the transition and context by using gateway treatments such as curb extensions, raised crossings, and small corner radii. Use these design elements so that people turning onto the narrower street become aware of entering a slow-speed environment.

Existing Conditions

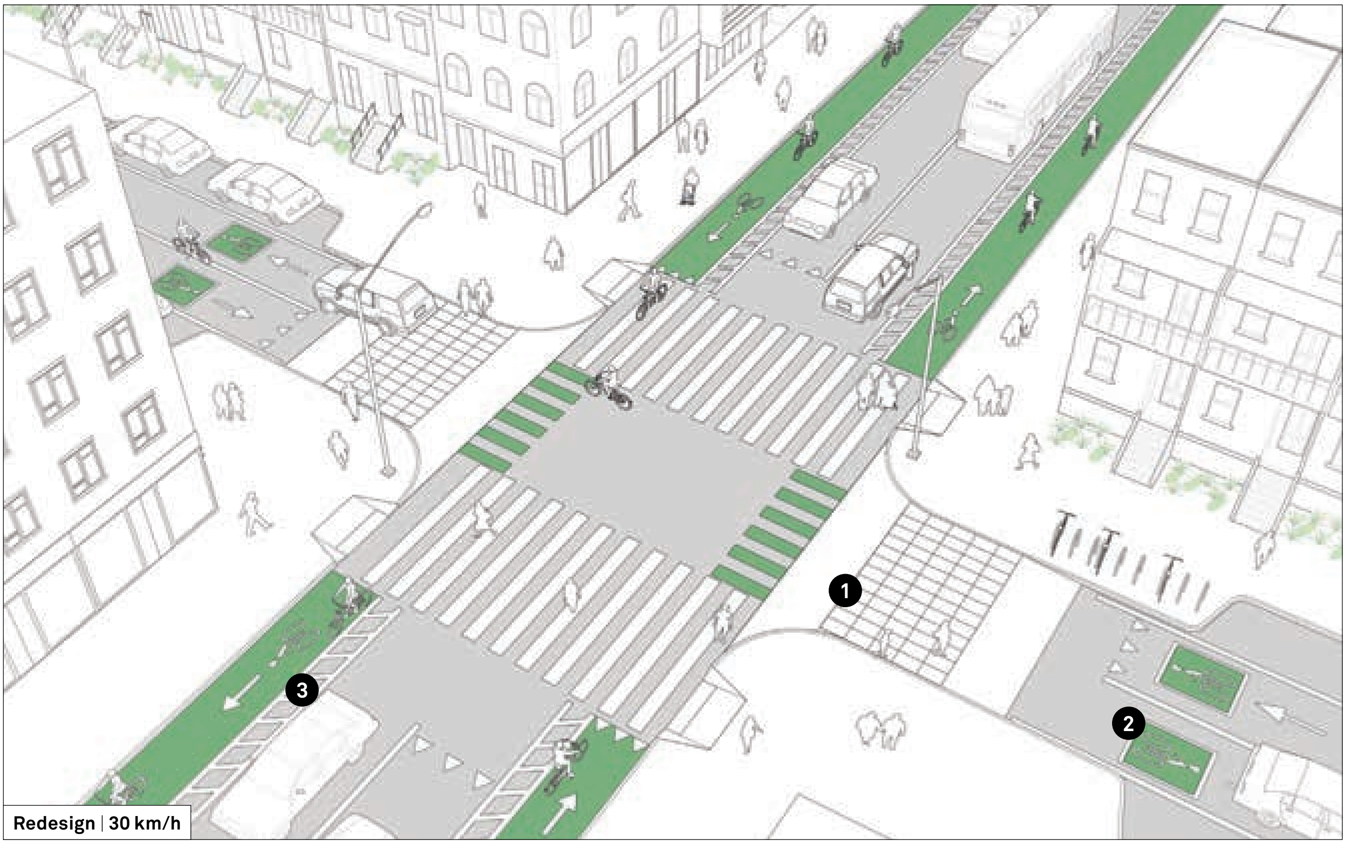
This illustration depicts a two-way thoroughfare intersecting a residential two-way street.

Recessed pedestrian crossings increase the walking distances for pedestrians, who tend to cross at non-marked locations. While each street plays a different role at the network level, their hierarchy is unclear at the intersection.

Vehicles parked at the intersection on the residential street obstruct mutual visibility between motorists and pedestrians. The pedestrians have to step onto the roadbed to see if a vehicle is coming, and to be seen by drivers.

On the larger street, cyclists and pedestrians, though legally permitted to cross, are implicitly discouraged from doing so by design.

Vehicles often fail to yield at these locations and have few design cues to suggest they should.



Design Guidance

This reconstruction establishes a clear hierarchy between the two streets, taking into consideration all users and the role of each street within the larger network.

1. Raise the pedestrian crossings at the entrances to residential streets to prevent motorists from speeding when entering the street. This prioritizes pedestrian safety and increases legibility.

2. Introduce shared-lane markings and advanced stop boxes to prioritize cyclists at the intersection. A maximum speed of **30 km/h** is recommended on the residential street and the use of traffic calming measures is encouraged.

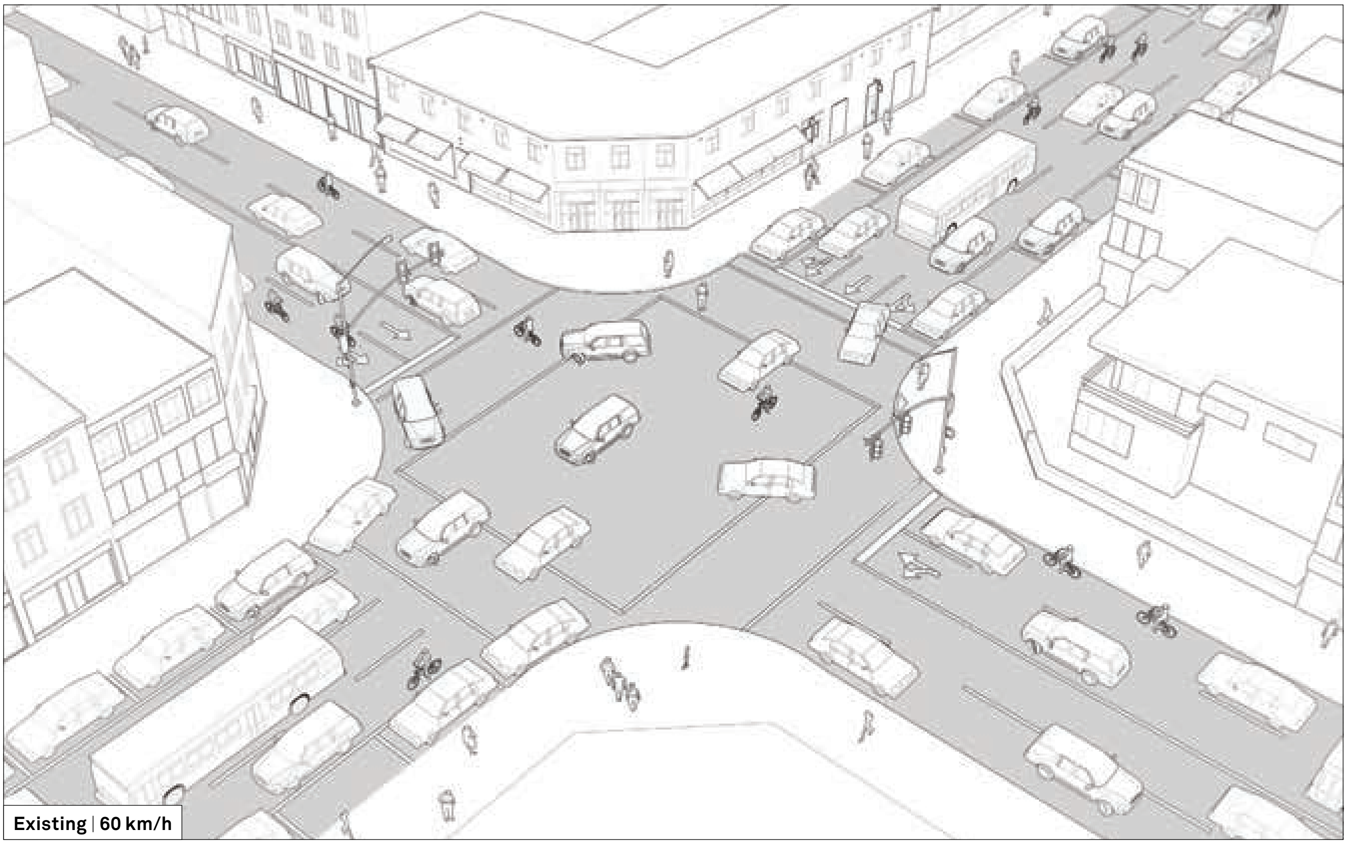
3. Add buffered cycle lanes on wider streets to create a safer environment for cyclists.

Install curb extensions onto the smaller streets to reduce pedestrian crossing length, protect pedestrians, and prevent motorists from parking at the intersection corners.

Utilize these curb extensions for cycle parking, green infrastructure, and street furniture.

Fortaleza, Brazil

11.7 | Intersection of Two-Way and One-Way Streets | Example



The meeting of one- and two-way streets provides an opportunity to redesign the intersections to be more compact, reducing pedestrian crossing distances and reclaiming public space. Rethink intersection geometry, signal timing, and traffic volumes to formulate a design that clarifies the hierarchy of street users, while enhancing the safety and legibility of the intersection.

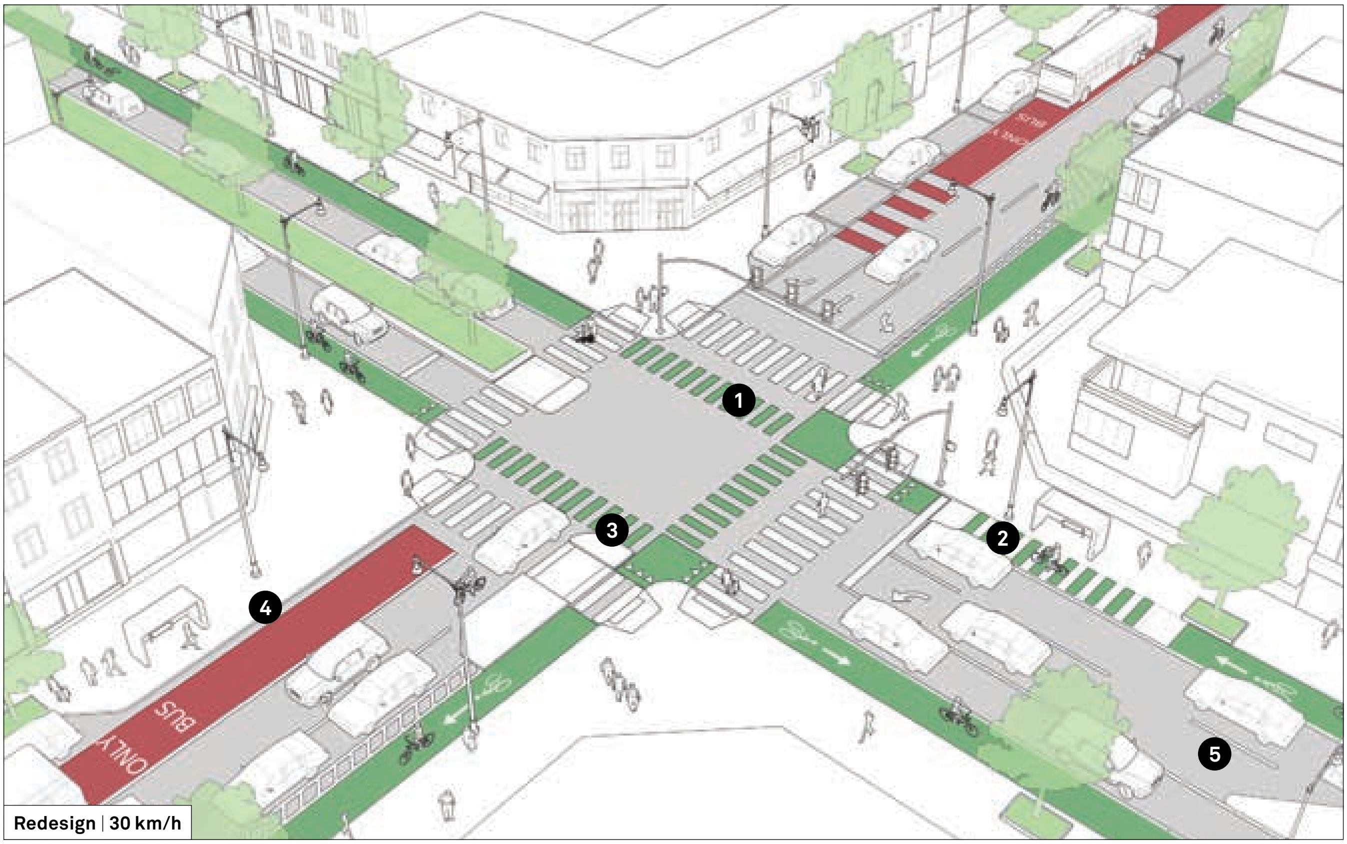
Existing Conditions

This example illustrates an intersection where a wide, one-way street—with three travel lanes and curbside parking—meets a two-way street with two travel lanes in each direction.

At these intersections, cyclists and pedestrians suffer from long exposure times when crossing the street.

Large corner radii encourage high-speed turns while the absence of refuge space fails to convey safety within the busy intersection. Stop lines that are either too close to the pedestrian crossings or not marked limit the capacity of motorists to react in a situation of risk.

Unregulated parked vehicles may encroach on the pedestrian crossing and expose vulnerable users to turning vehicles and oncoming traffic.



Design Guidance

This reconstruction demonstrates the use of curb extensions, bus bulbs, and refuge islands to create a safer and more balanced intersection.

Maintain one mixed traffic lane on the one-way street. Introduce a dedicated transit lane and a parking-protected cycle track by removing a travel lane and offsetting the parking lane.

The dedicated transit lane is designed to be a shared right-turn lane to allow a moderate volume of right turns. The curb is extended to within **6 m** of the lane's edge to reduce the effective turn radius, slowing right turns and protecting pedestrians crossing.

1 Extend ground markings for cycle lanes through the conflict zone of the intersection, matching the width and positioning of the leading cycle lanes.

Manage turns across the cycle track using a leading cycle/lagging left-turn phase.

2 Where transit is in mixed traffic on the two-way street, avoid conflicts at transit stops by raising cycle lanes and changing markings. This helps to reduce cycling speeds and provide at-grade access to transit passengers. In such a configuration, cyclists must yield to pedestrians.

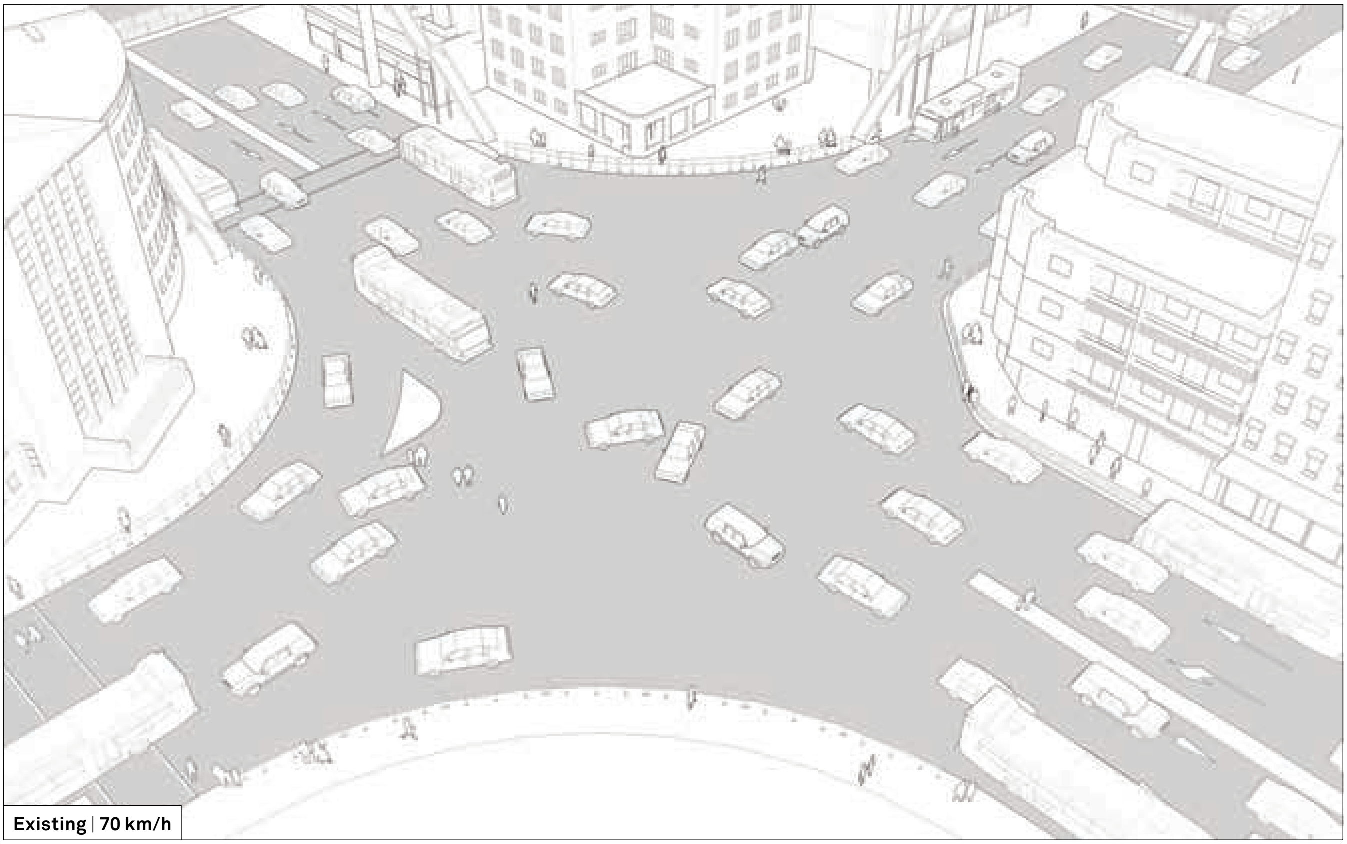
3 On the one-way street, create pedestrian refuge islands in line with the parking lane to reduce pedestrian crossing distance. Where geometry allows, install refuge islands.

4 Bus bulbs provide a dedicated space for passengers to wait, improving transit travel times with more efficient boarding. Far-side transit stops are preferred in conditions in which conflicts with turning vehicles are common.

5 Provide turn lanes by introducing a recessed central median on the two-way street. Turn lanes provide protected turns across oncoming traffic.

New York City, USA. A pedestrian refuge island and green infrastructure strategies are aligned with the parking lane, reducing crossing distances and increasing the safety of the intersection.

11.8 | Major Intersection: Reclaiming the Corners | Example



Existing | 70 km/h

The intersection of two major streets can act as both a barrier and a node. Redesigning major intersections requires a critical evaluation of the tools and trade-offs available to make an intersection work better for everyone.

Weigh intersection geometry, signal timing, and traffic volumes to formulate a design that clarifies the hierarchy of street users, while enhancing the safety and legibility of the intersection.

Existing Conditions

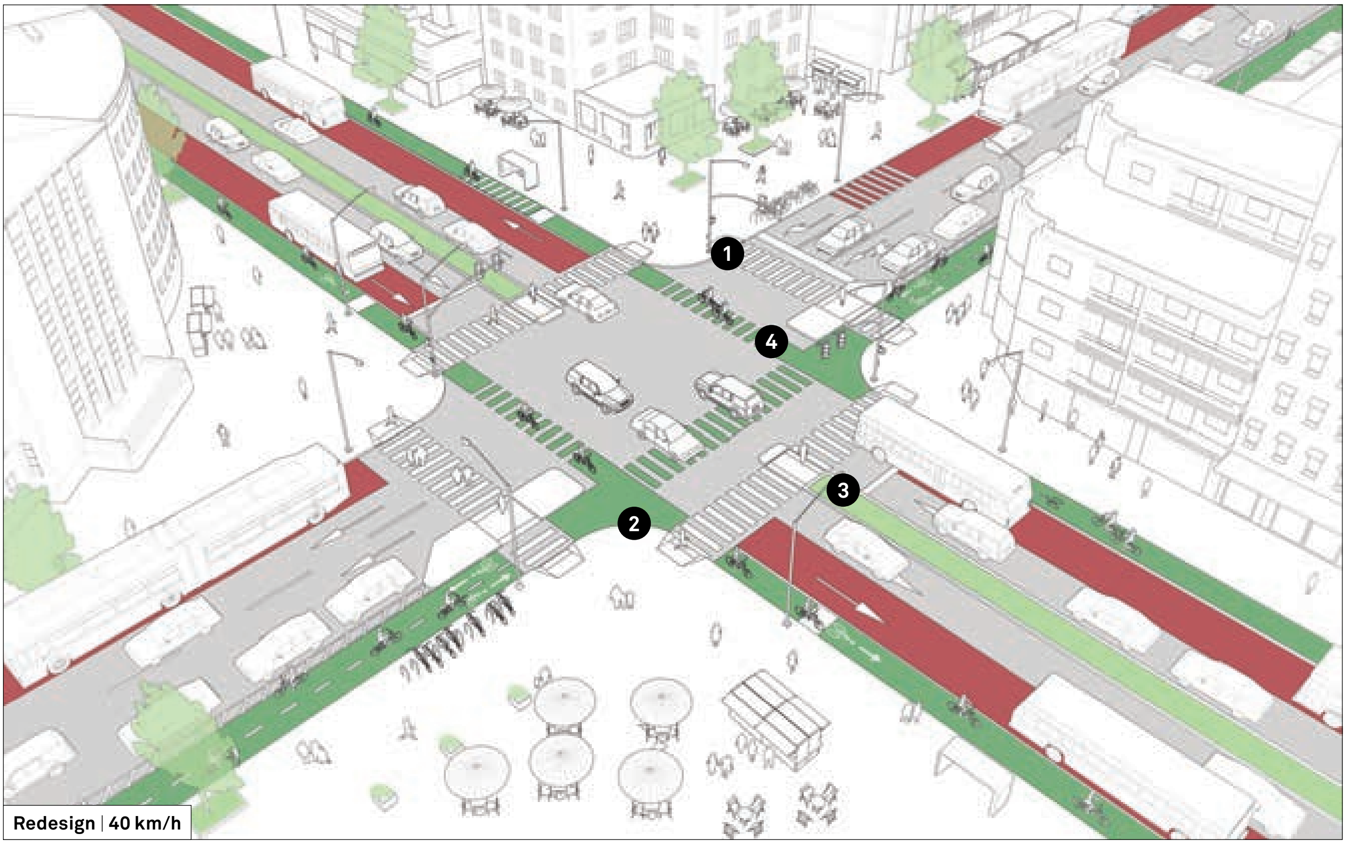
In this illustration, a large, one-way street with four travel lanes intersects with a two-way street carrying three lanes in each direction. This intersection is extremely wide and chaotic, with an unbalanced allocation of space between modes. It has long traffic signal cycles.

Designed primarily for motorists, the sidewalks are too narrow or non-existent.

Crossing facilities are grade-separated by overhead foot bridges that significantly increase the travel time for pedestrians and are inaccessible to those facing ambulatory difficulties.

Fences along the sidewalk, installed to prevent people from walking on the roadbed and to impede illegal parking, further increase walking distances. These are often utilized by vendors to display goods.

Large corner radii designed to accommodate high-speed turns and inadequate pedestrian refuge islands present a danger to vulnerable users. Slip lanes at the corners encourage high speeds for motorists turning without having to pause.



Design Guidance

This reconstruction shows the conversion of a large car-oriented intersection into a compact, well-delineated, and safer node.

1 Remove pedestrian overpasses and replace them with at-grade crossings. This reduces crossing time and distance, increases sidewalk space, and makes the pedestrian crossing accessible for all users.

2 Reduce turning radii and reclaim space at the corners to safely accommodate high pedestrian volumes. This creates additional space for transit stops and street vendors.

Install pedestrian refuge islands to reduce crossing distance and provide a protected waiting space.

3 Reduce the lane width and extend the central median as a simple, cost-effective measure to improve safety.

4 Extend ground markings for cycle lanes through the conflict zone of the intersection, matching the width and positioning of the leading cycle lanes.

Prioritize mass transit to increase the capacity on busy streets. Convert a travel lane in each direction of the two-way street, and one lane of the one-way street, into transit-only lane.

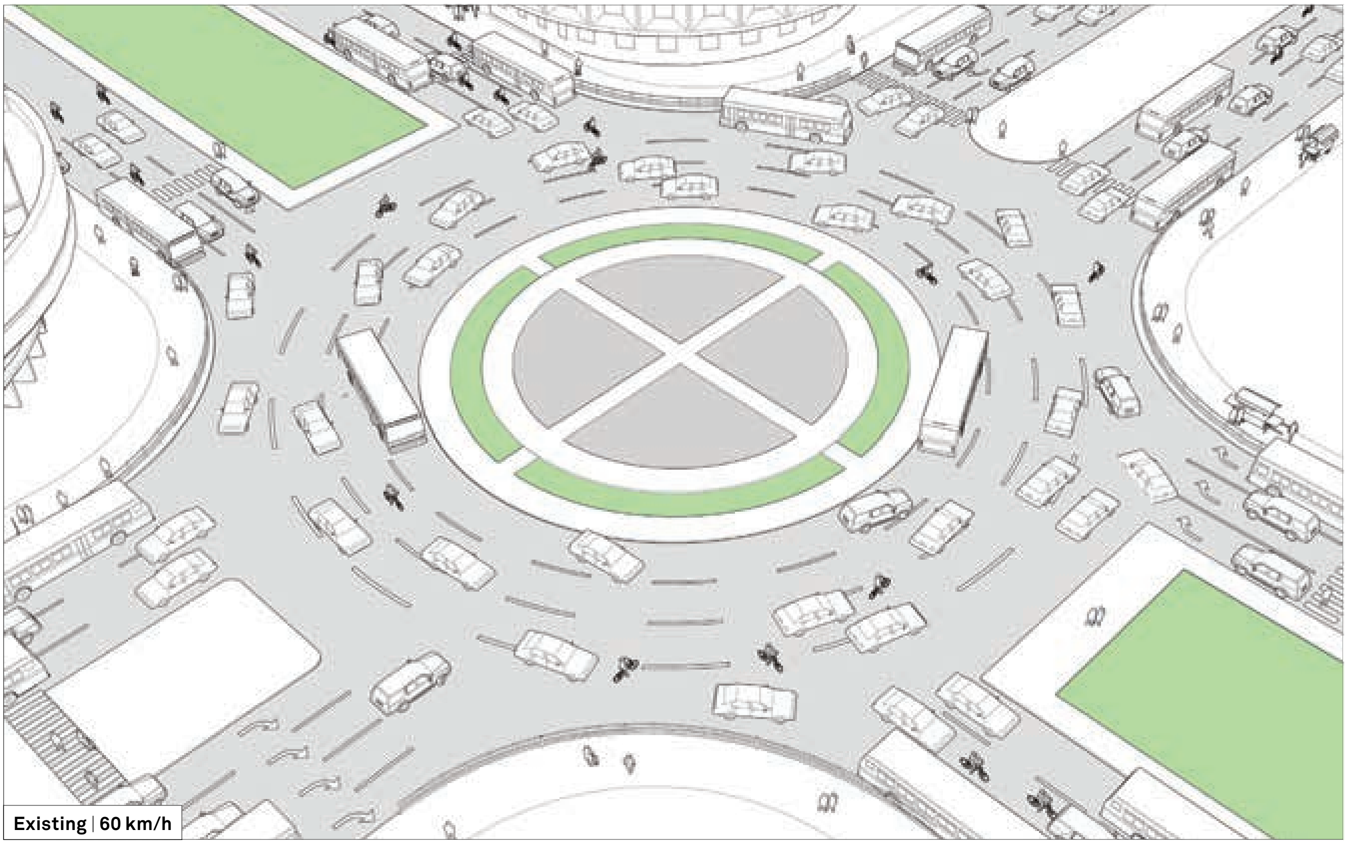
On the one-way street, remove one travel lane to add a parking-protected, two-way cycle track.

On the two-way street, add a raised cycle track on each side of the street, ramping lanes up to meet sidewalk level when they are adjacent to transit stops. Ensure a change in markings to indicate these potential areas of conflict between cyclists and transit riders.

Define travel lanes through markings and reduce their width in order to reduce vehicular speed.

Addis Ababa, Ethiopia. An interim transformation showcasing the principles such as tightening the corner radii, adding appropriate intersection markings and reducing crossing distances.

11.9 | Major Intersection: Squaring the Circle | Example



Existing Conditions

The illustration above depicts a wide, unsignalized intersection with a large, landscaped—but inaccessible—roundabout. Central medians divide the two-way traffic on both cross streets.

The large roundabout negates many of the benefits of a compact roundabout, such as managing speeds and reducing conflicts, given the large turning radii and minimal level of deflection required for moving vehicles.

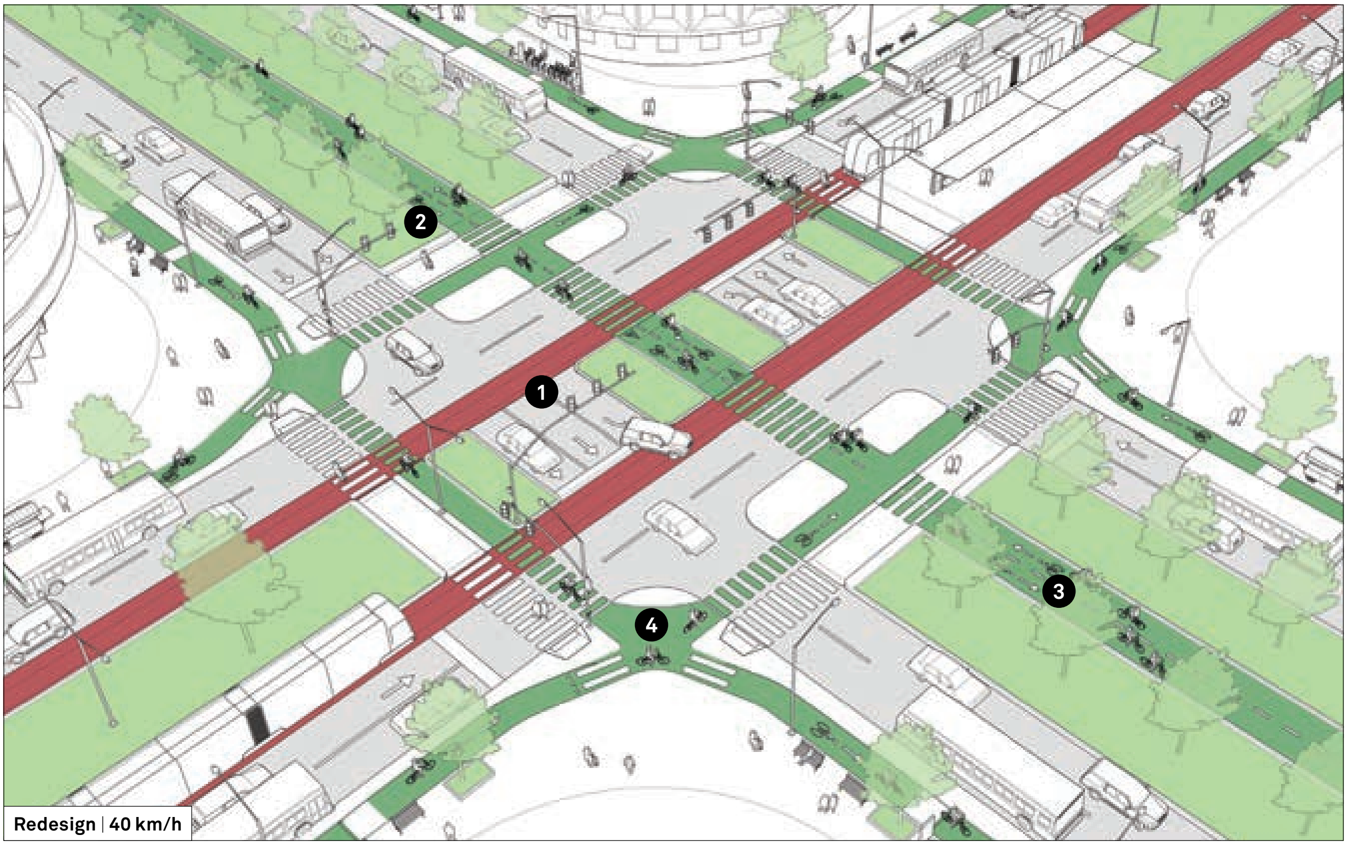
This intersection creates an unbalanced allocation of space between modes.

The central space is difficult to access due to high traffic volumes and a lack of pedestrian crossings.

Pedestrian crossings are inconsistent and recessed from the intersection, increasing walking distances.

Addis Ababa, Ethiopia. A very wide traffic circle where the central space is inaccessible. Pedestrians have to cover very long distances in order to cross the street due to the wide diameter of the traffic circle. Sites like this present a great opportunity for redesign.

Ho Chi Minh City, Vietnam. A vulnerable user in a wheel chair tries to cross the street at a busy roundabout with no pedestrian crossings.



Design Guidance

This reconstructions shows the transformation of a roundabout into an orthogonal configuration with signalized traffic control and a more balanced allocation of space between different modes.

Reduce lane widths and add dedicated transit lanes, protected cycle facilities, and an improved walking environment.

Reduce corner radii to limit the speed of turning vehicles. Reclaim these corners for additional pedestrian space and to shorten crossing distances.

1 Align the number of travel lanes through the intersection. Mark skip lines to direct users on continuous paths.

Introduce dedicated, bidirectional transit facilities to reduce traffic congestion and increases total street capacity.

Ban turns that cross the transit lanes on unsignalized intersections.

2 Take steps to activate wide central medians, which are valuable but underused public space. Use the wide median along the transit corridor for transit shelters and stations. Design refuge spaces to align with pedestrian crossings, to provide access to stations, and to offer seating opportunities recessed into landscape.

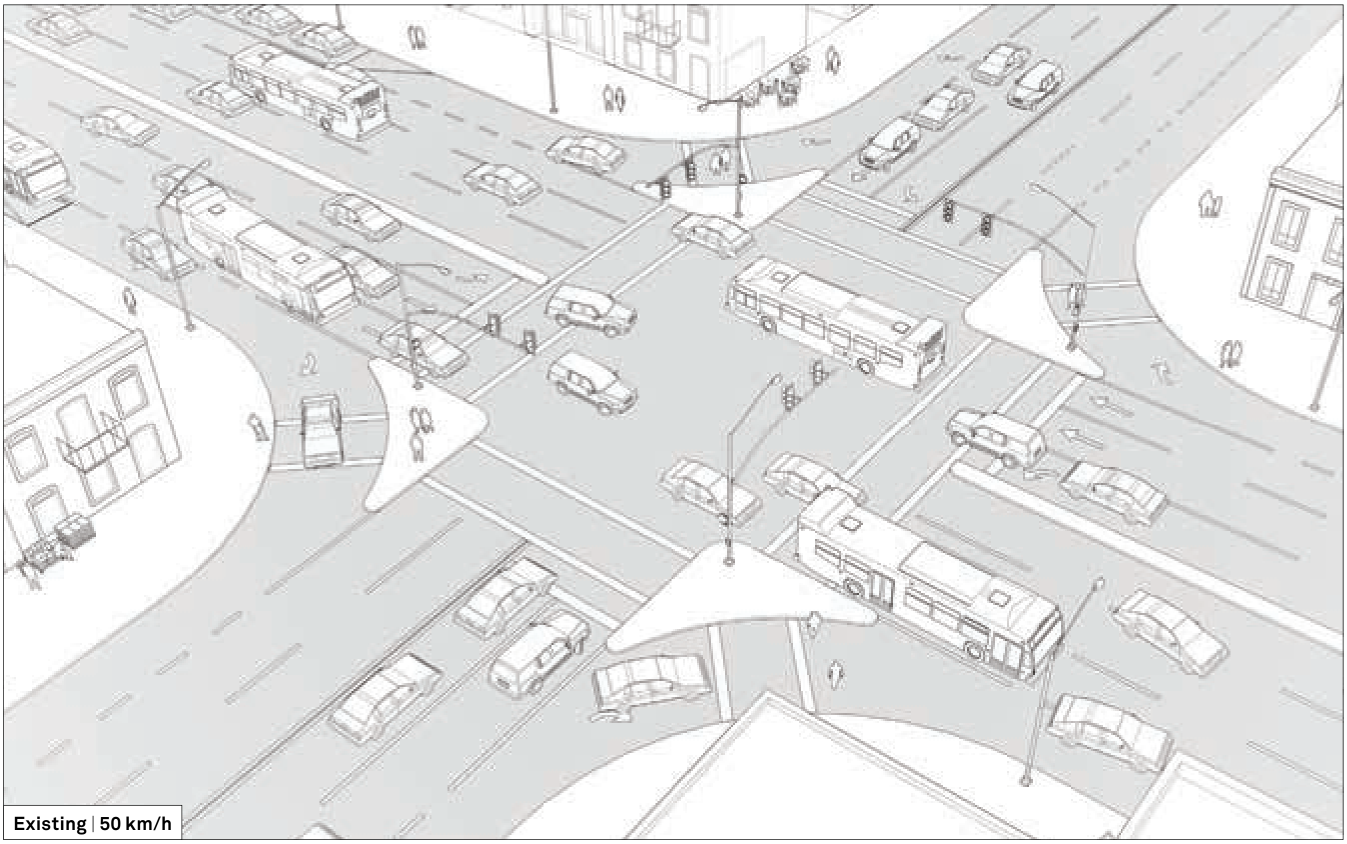
3 A bidirectional cycle track is installed in the center median to create activity and utilize the space for mobility and recreational use. The cycle track is continuous, with a protected center crossing and access to side-running cycle tracks on either street.

4 Protect cyclists by adding corner refuge islands and forward stop bars that make them more visible to oncoming and turning vehicles.

Wide medians should be landscaped and planted to increase permeability, water infiltration, shade, and biodiversity.

Bogota, Colombia. A bidirectional bike lane in the central median.

11.10 | Major Intersection: Cycle Protection | Example



Existing Conditions

The above illustration shows the intersection of two large two-way streets, both with three lanes in each direction. This intersection is signalized.

This extremely wide intersection has an unbalanced allocation of space between modes. Wide corner radii and slip lanes prioritize motorists and encourage high-speed turns.

Long pedestrian crossing distances and a lack of refuge islands extend the conflict zone for pedestrians and increase the risk of being hit by a vehicle.

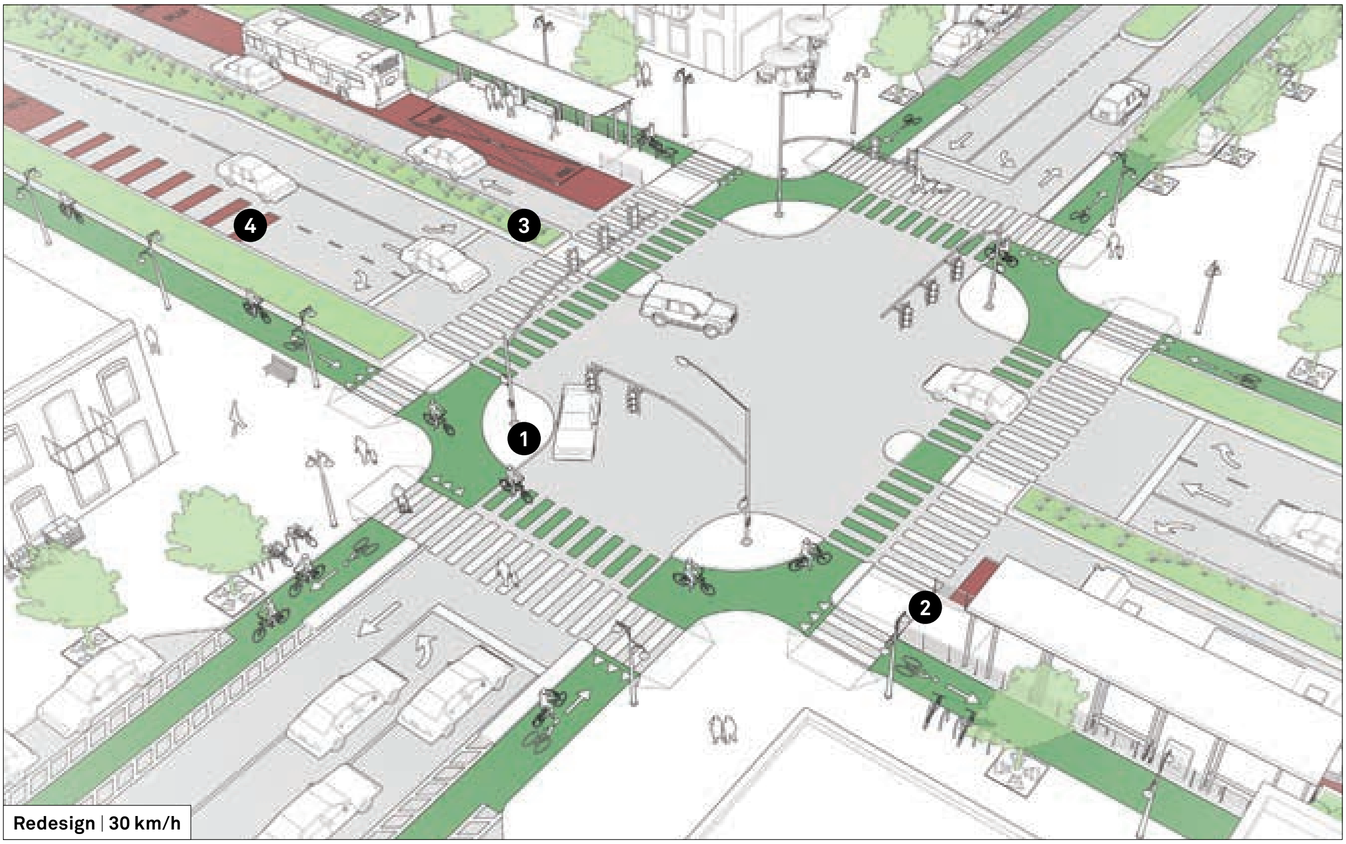
Cycle facilities are nonexistent so cyclists are exposed to unsafe conditions and conflicts with turning vehicles.

A lack of pedestrian ramps at the sidewalks and refuge islands results in an inaccessible intersection.

Vehicles turning across oncoming traffic without a dedicated signal phase present dangerous conditions to pedestrians crossing the street.

Mumbai, India

Bangkok, Thailand



Design Guidance

This reconstruction demonstrates an intersection design which prioritizes safety for all users and not just motorists.

Protected cycle tracks are provided in each direction on one street, and buffered cycle lanes are provided on each side of the street of the other.

1 This protected intersection, also known as a Dutch intersection, provides safe refuge spaces for cyclists where the various cycle facilities meet; all cyclist turns become two-stage turns, and cyclists are given priority position using advanced stop boxes, leading signal priority, and smaller curb radii to slow vehicles turning across the cycle path. *See 6.4: Designing for Cyclists.*

Dedicated transit lanes run adjacent to side-running cycle tracks, with boarding island stops to organize interactions between cyclists, transit vehicles, and transit riders at stop locations.

2 The side-boarding transit island not only eliminates conflict between cyclists and transit vehicles, but provides additional refuge space and shortened crossing distance for pedestrians. Cycle tracks may be raised or at street-level through the boarding island, but must adequately consider strategies to encourage cyclists to yield to pedestrians.

Extend sidewalks and curbs to provide safer and shorter pedestrian and cycle crossings and protect them from motorized traffic.

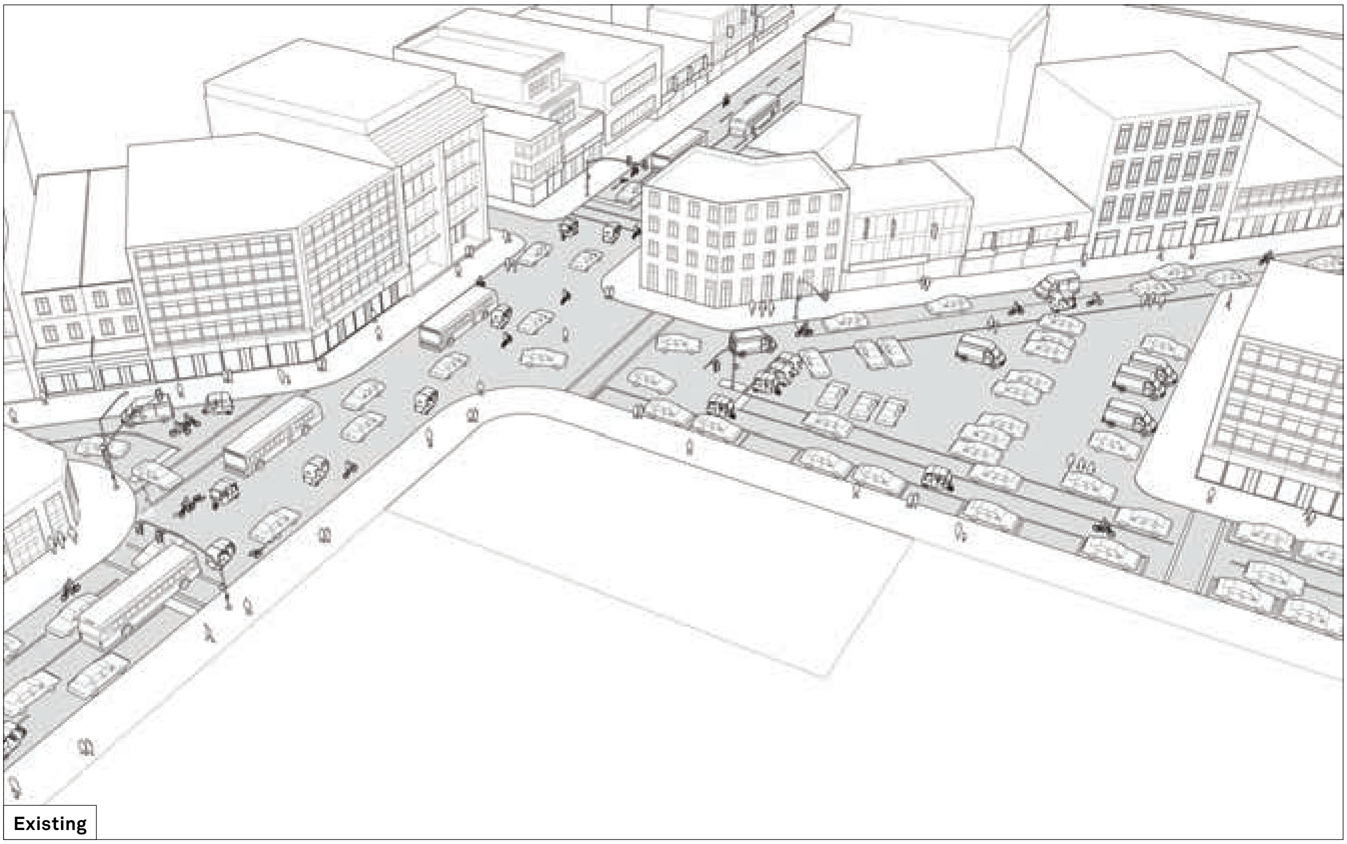
3 Remove slip lanes and add signalized turn lanes for vehicles turning across oncoming traffic. Design turn lanes by recessing the central median.

4 When traffic volumes are relatively low, the transit lane may be shared with near-side turning vehicles. In this case, it is preferable to install a far-side bus stop configuration to minimize turning conflicts, which would impact boarding operations.

Delft, The Netherlands

Added medians play an important safety role, but they are also crucial for urban green networks, especially at intersections where the network can be disconnected. Add landscaping and plantings to these elements. *See 7.2: Green Infrastructure.*

11.11 | Complex Intersection: Adding Public Plazas | Example



Existing

Complex intersections, especially those situated in busy commercial areas or at the junction of several streets, have tremendous potential to fulfill latent demand for public space. Non-orthogonal intersections are common in irregular and spontaneous urban fabrics and when two or more orthogonal grids meet. Lacking legibility, these intersections present safety hazards to all users.

Existing Conditions

This illustration depicts a large, signalized, complex intersection. Traffic volumes and multi-phase signals result in long delays and confusion among all users.

Acute-angled intersections reduce visibility for motorists, while obtuse intersections allow for high-speed turns and unnecessarily long pedestrian crossings.

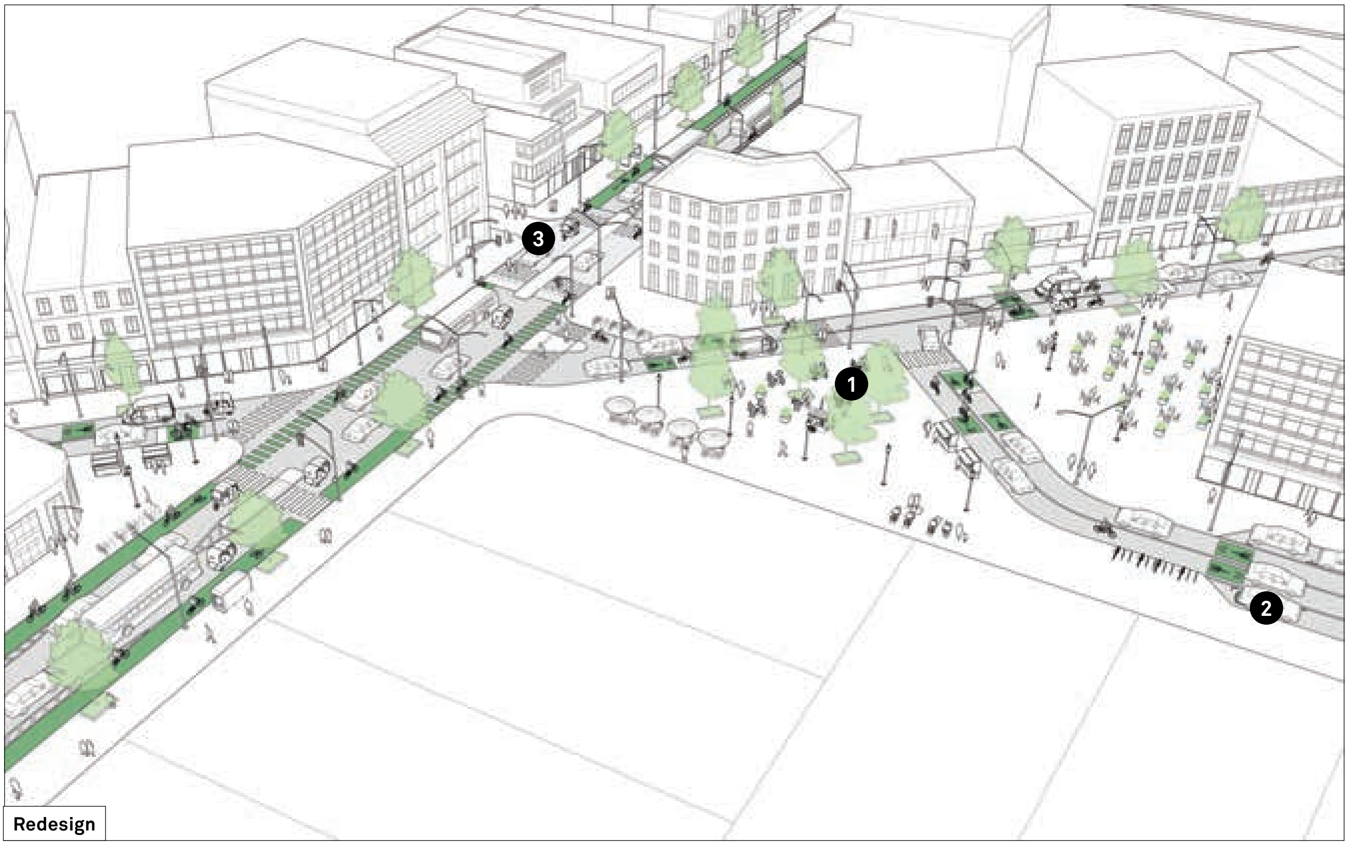
Here, a major street intersects with two smaller streets and a diagonal street, creating a residual space that becomes de-facto parking.

The complex geometry results in long and recessed crossings, making it difficult for all users to navigate the intersection.

Before

After

São Paulo, Brazil.



Redesign

Design Guidance

The intersection is transformed by simplifying and prioritizing the orthogonal geometry, adding public space, and changing the function of smaller streets.

Redesign intersections to be as close to 90 degrees as possible, implementing turn restrictions and street reversals where applicable.

Prioritize the primary street and use curb extensions on the diagonal streets to facilitate a perpendicular intersection.

Simplify the geometry and reduce the number of streets intersecting simultaneously, to eliminate the need for multi-phase signalization.

Plan signal timing to align concurrent and non-conflicting movements that reduce phases and cumulative cycle length, improving operational efficiency.

1 Convert the residual space into a pedestrian plaza. Work with local businesses and residents to program, manage, and maintain the newly created public space. *See 10.3.4: Pedestrian Plazas.*

2 Reorganize curbside parking and recess it from the intersection.

3 Consider the transformation of one of the small streets into a pedestrian space or a shared space to further simplify the intersection and improve vibrancy of the area. Add a raised crossing and a pedestrian refuge island to provide a safer crossing and direct access to the new pedestrian-priority street.

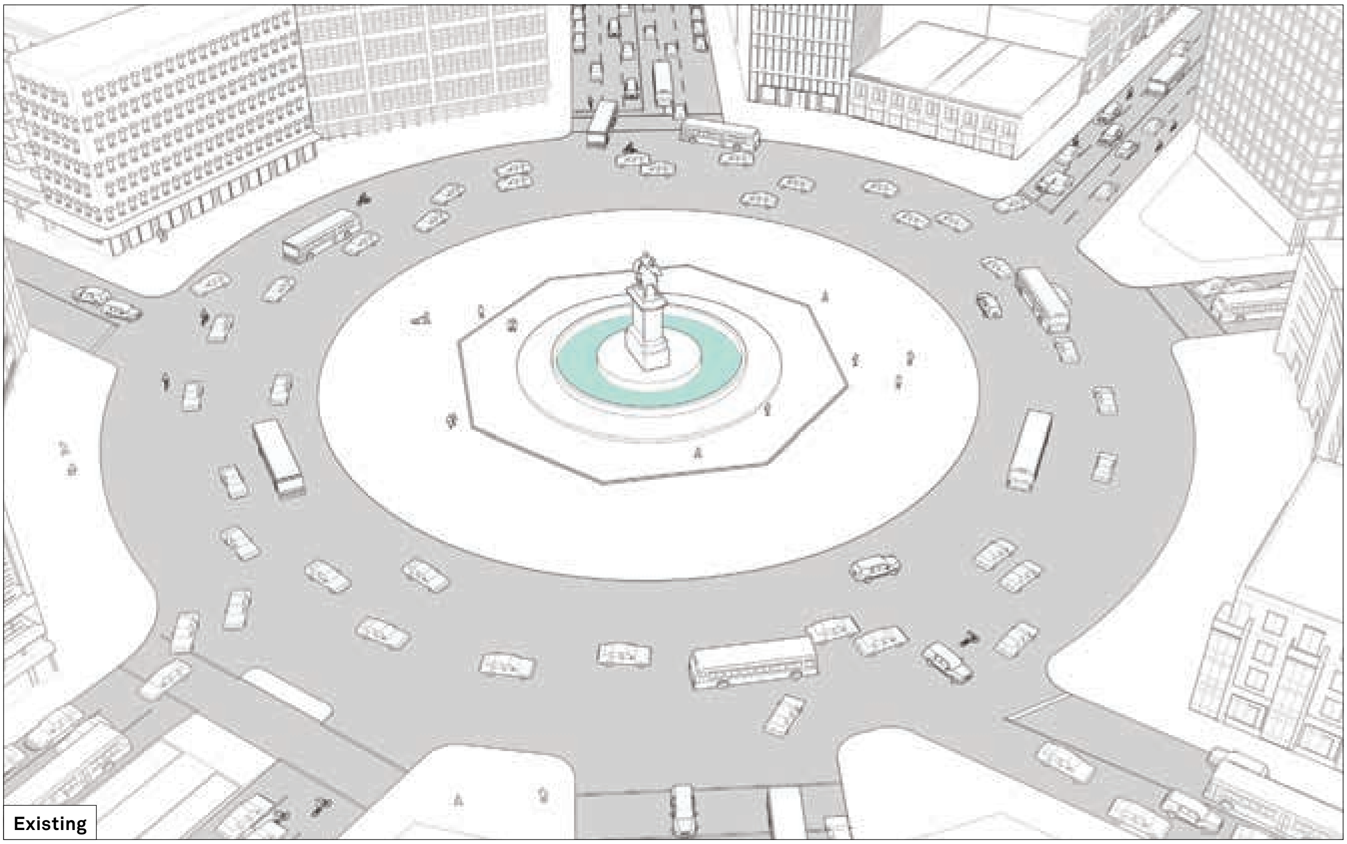
Align curb extensions, pedestrian refuge islands, and pedestrian crossings with sidewalks to reduce crossing distances and increase pedestrian safety and convenience.

Mark conflict zones for cycle facilities through the intersection and plan Advanced Stop Bars. *See 6.4: Designing for Cyclists.*

Buenos Aires, Argentina.

Cyclists are more exposed in obtuse and ambiguous intersections, so conflict markings must be prominent and may be supplemented by leading cycle intervals to improve safety.

11.12 | Complex Intersection: Improving Traffic Circles | Example



Existing Conditions

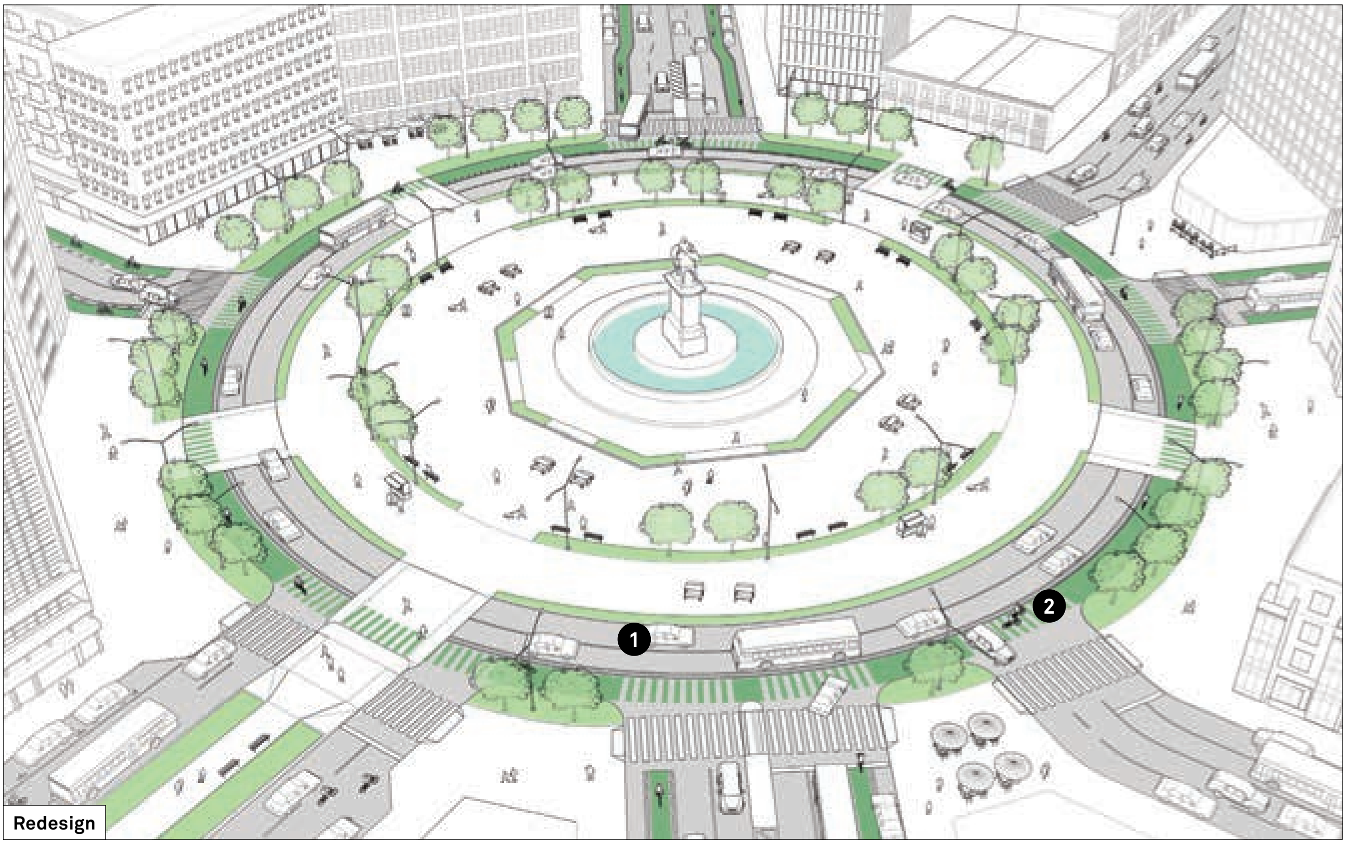
Many cities have large traffic circles with inaccessible central spaces, complex traffic patterns, and hazardous conditions for all users.

This illustration depicts a large roundabout in which seven streets enter at a number of angles, resulting in motorists entering the roundabout at differing speeds and with variable sight lines. A confusing assembly of one- and two-way streets entering the intersection creates a fast-moving, perplexing traffic pattern.

The large roundabout negates many of the benefits of a compact roundabout, such as managing speeds and reducing conflicts.

The wide central space is almost inaccessible to pedestrians. Unmarked, multiple travel lanes result in dangerous conditions for vulnerable users. No cycle facilities are provided.

Cairo, Egypt



Redesign

Design Guidance

The intersection is redesigned to facilitate better movement for all users, and to improve the usability, safety, and quality of the central open space.

Extend the central space and provide raised pedestrian crossings to ensure safe access while slowing vehicular traffic.

1 Reduce the roundabout to two travel lanes, decreasing the number of conflicts and lane changes occurring in the circle.

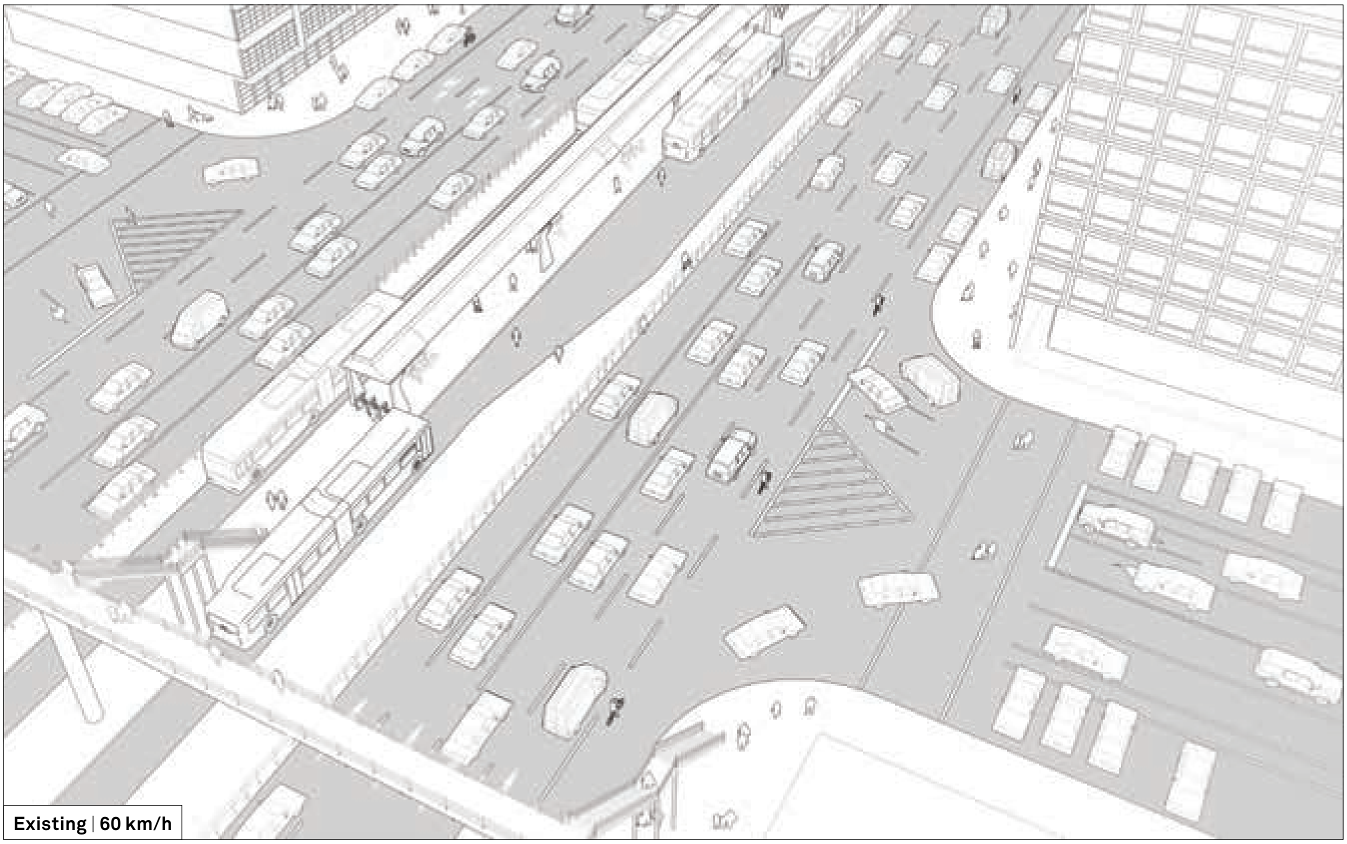
Reconfigure street approaches to as close to 90-degree angles relative to the traffic circle as possible. Ensure all entering vehicles have clear sightlines to oncoming traffic of all modes, and stop or slow all entering vehicles.

Extend sidewalks and the central plaza, dedicating space to street vendors and other active uses. Add planting, trees, seating, lighting, and other street furniture to make the central space more attractive and functional.

2 Clearly demarcate paths for cyclists throughout the intersection as various cycle facilities on adjacent streets meet the traffic circle. Install cycle lanes on the outside of the roundabout to reduce interaction with vehicles, and change marking pattern at points of potential conflict.


Fuentes de Cibeles; Mexico City, Mexico

11.13 | Complex Intersection: Increasing Permeability | Example



Existing | 60 km/h

Existing Conditions

The introduction of a collective transport system, such as Bus Rapid Transit (BRT) or a light rail, may radically transform streets and intersections, with the only goal of increased efficiency of the transit service.

These corridors may continue for several blocks without intersections in order to avoid conflicts with crossing traffic. Pedestrians are channeled onto overhead bridges, and cyclists are forced to take long detours.

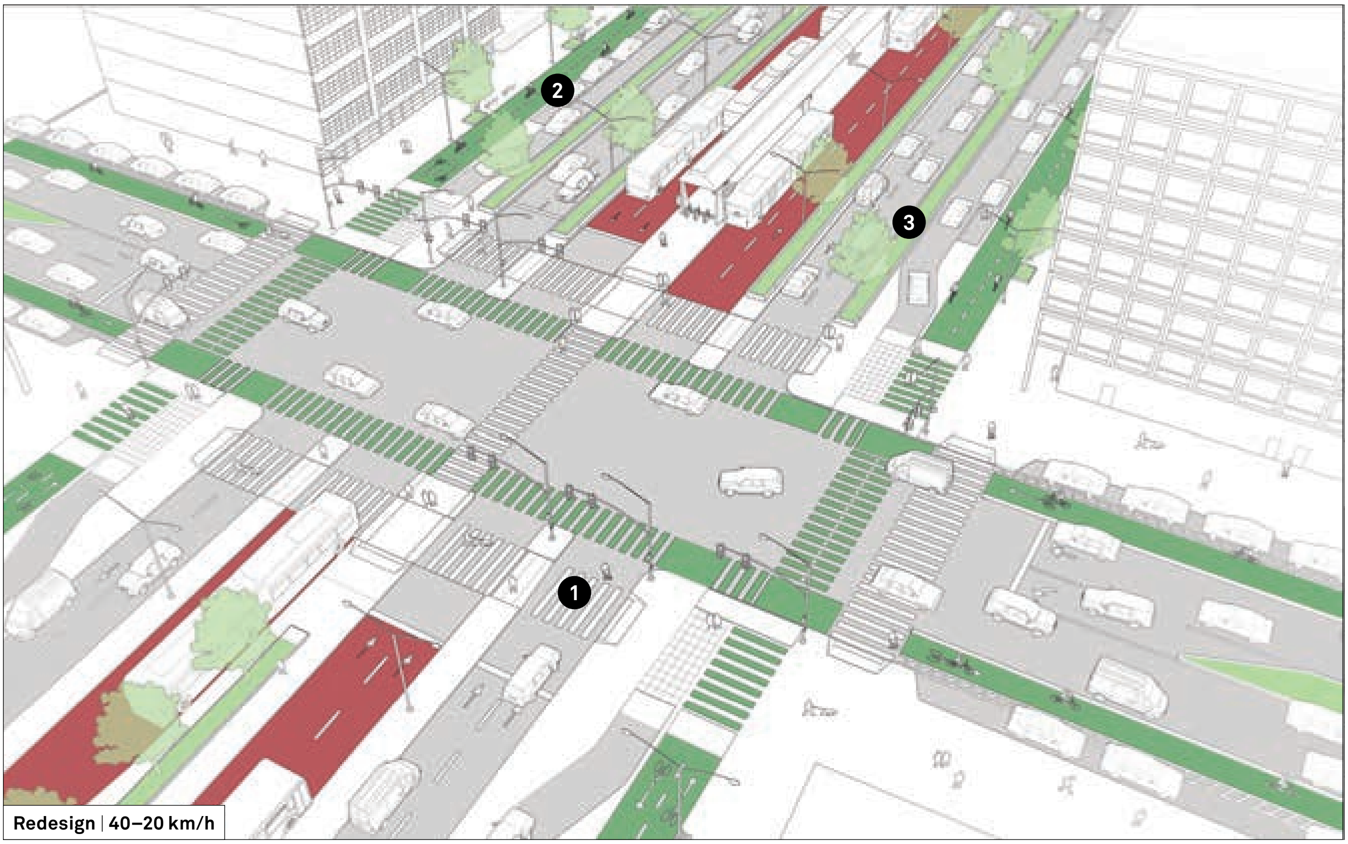
The illustration above depicts a main corridor designed to prioritize the through-movement of vehicles and mass transit. The central corridor does not intersect with local streets. Vehicles coming from the local street must turn right to proceed.

Cyclists ride in mixed traffic or on sidewalks, increasing the risk of conflict with motorists and pedestrians.

Large corner radii and wide lanes encourage speeding, and fences along the transit corridor prevent pedestrians from crossing it.

Bogota, Colombia

Crossing facilities are grade-separated and pedestrians are required to use elevated bridges to cross the street and to access the central boarding island for transit.



Redesign | **40–20 km/h**

Design Guidance

The intersection is redesigned to increase permeability, prioritize pedestrians, and encourage non-motorized uses while maintaining an efficient transit system.

1 Remove overhead bridges and replace them with at-grade crossings at intersections and mid-block locations, allowing pedestrians to directly access the transit stops at grade.

Provide curb extensions and refuge islands to shorten crossing distances.

2 Introduce parking-protected cycle tracks and buffered cycle lanes to provide a safer environment for cyclists.

Bidirectional cycle facilities on each side of this wide street reduce the need to cross the transitway and provide a high-quality corridor for the entire cycle network. Extend ground markings for cycle lanes through the conflict zone of the intersection, matching the width and positioning of the leading cycle lanes.

Remove fences in the median and replace them with planters and rows of trees on each side of the transit way.

3 Separate local traffic and through-traffic. Remove curbside parking from the main roadway; instead provide it in the service lane where the speed is limited at **20 km/h**.

Recess parking from the intersection. Raise crossings and provide distinct treatments for the service lane to slow speeds and increase visibility between vehicles, cyclists, and pedestrians.

Yinchuan, China

Manage or restrict turns across oncoming traffic to improve reliability of the transitway and overall safety. *See 8: Operational and Management Strategies.*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Kelly Henning
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Rebecca Bavinger

Advisory Board

Janette Sadik-Khan
Linda Bailey
Hal Harvey
Margaret Newman
Helle Soholt
Darren Walker
Mark Watts

Global Designing Cities Initiative

Skye Duncan
Ankita Chachra
Abhimanyu Prakash
Fabrizio Prati

National Association of City Transportation Officials

Linda Bailey
Laurie Almian-Derian
Alex Engel
Kate Fillin-Yeh
Ted Graves
Corinne Kisner
Matthew Roe
Craig Toocheck
Aaron Villere

Bloomberg Associates

Janette Sadik-Khan
Nicholas Mosquera
Seth Solomonow
Andrew Wiley-Schwartz

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Johns Hopkins Bloomberg School of Public Health
The World Bank-Led Global Road Safety Facility
Vital Strategies
World Health Organization

C40

Seth Schultz
Clare Healy
Laura Jay
Gunjan Parik
Kathryn Urquhart

CONSULTANTS

Arup

Susan Ambrosini
Gabriela Antunes
Anthony Durante
Ellen Greenberg
Penny Hall
Joseph Kardos
Pablo Lazo
Vincent Lee
Trent Lethco
Paula Saad
Varanesh Singh

Nelson Nygaard

Michael King
Ria Lo
Paul Moore
Karina Ricks
Jeffery Tumlin
Shivam Vohra
Stephanie Wright

MRCagney

Peter Breen
Steven Burgess
Chris Dowie
Melissa Dunlop
Gerard Reardon
Will Somerville

Sam Schwartz Engineering

Michael Flynn
Sam Frommer
Vig Krishnamurthy

Pure + Applied

Paul Carlos
Urshula Barbour
Chris Mills
Shantal Henry
Miles Baretto
Nick Cesare
Karilyn Johansen
Carrie Kawamura

Others

Lee Altman
Anita Bulan
Guangyue Cao
Thomas F. Reynolds
Maria Agustina Santana
Ziyang Zeng

GLOBAL CONTRIBUTORS

Argentina

Buenos Aires
Soledad Aguirre Sors
Guillo Dietrich
Juanjo Mendez
Sol Mountford

Australia

Gosford
Judy Jaeger
Melbourne
Rob Adams
Steven Burgess
Leanne Hodyl
Rob Moore
Stuart Niven
Bart Sbeghen
Ros Rymer
Sydney
Sandy Burgoyne
Kerry Gallagher
Simon Lowe
Emily Scott
Victoria State
Kristie Howes
Giles Michaux
Daniel Przychodzki
Lorrae Wild

Azerbaijan

Baku
Vusal Rajabli

Brazil

Fortaleza
Ezequiel Dantas
Diego França
Porto Alegre
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Marta Obelheiro
Rio de Janerio
Priscila Coli Rocha
Clarisse Cunha Linke
Mauricio Duarte Pereira
Washington Fajardo
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São Paulo
Ciro Biderman
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Canada

Toronto
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China

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Bogota
Leidy Constanza Lopez Mateus
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Medellín
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Sofie Kvist
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Ecuador

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Ana Maria Duran Calisto
Jaime Izurieta-Varea

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Ethiopia

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Reeta Putkonen

Georgia

Tbilisi
Gela Kvashilava

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Burkhard Horn
Joerg Ortlepp
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Stelios Efstathiadis

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Cite Soleil
Louino Robillard

India

Ahmedabad
Anuj Malhotra
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Raj Cherubal
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Piyush Tewari

Indonesia

Bandung
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Israel

Jerusalem
Ofer Manor

Kenya

Nairobi
Cecilia Andersson
Christopher Kost
Hilary Murphy
Laura Petrella
Robyn Watson

Korea

Daegu
Keong-Gu Hong
Seoul
Yong-Jin Cho
Noh Soo Hong

Kosovo

Prishtina
Bekim Ramku

Kyrgyzstan

Bishkek
Chinara Kasmambetova

Laos

Vientiane
Bradley D Schroeder

Mexico

Mexico City
Salvador Herrera
Alejandro Larios Morales
Dhyana Quintanar Solares
Monterrey
Gabriel E. Todd
Puebla
Adán Domínguez
Giovanni Zayas Franzoni

Moldova

Chisinau
Tatiana Mihailova

New Zealand

Auckland
Ludo Campbell-Reid
Hayley Fitchett
Simon Harrison
Don Mckenzie
Lennart Nout
Christchurch
Melizza Morales Hoyos
Hugh Nicholson
Wellington
Megan Wraight

Peru

Lima
Mariana Alegre Escorza

Russia

Moscow
Artur Shakhbazyan

Scotland

Glasgow
Gillian Black

Singapore

Singapore
Andrew David Fassam
Yi Ling Pang

South Africa

Cape Town
Katherine Ewing
Rashiq Fataar
Barbara Southworth

Sweden

Goethenburg
Suzanne Andersson
Stockholm
Daniel Firth
Svante Guterstam
Alexander Stahle

Switzerland

Geneva
Sandra Piritz

The Netherlands

Delft
Dick Van Deen
Rotterdam
Koen De Boo

Turkey

Istanbul
Merve Aki
Cigdem Corek

United States

Baltimore
Adnan Hyder
Andres Ignacio Vecino Ortiz
Boston
Michael Murphy
Jeffrey L. Rosenblum
Connecticut
Norman Garrick
Madison
Jason Vargo
Malden
David Vega-Barachowitz
New York
Philippa Brashear
Oscar Correa
David Grahame Shane
Eric Jaffe
Ethan Kent
Lee Jung Kim
Michael King
Michael Kodransky
Karen Lee
Geeta Mehta
Justin Garrett Moore
Richard Plunz
Andrew Rudd
Jeffrey Shumaker
Morana Stipisic
Gary Toth
Nans Voron
Portland
Nick Falbo
Peter Koonce
San Francisco
Illaria Salvadori
Paul Supawanich
Robin Abad Ocubillo
Seattle
Nathan Polanski
Washington, DC
Julie Babinard
Soames Job
Ben Welle

Vietnam

Ho Chi Minh City
Tra Vu

Zambia

Kalumbila
Carl Johan Collet

CASE STUDY CONTRIBUTORS

Strøget, Copenhagen

Helle Soholt, Gehl Architects
Lars Gemzoe, Gehl Architects
Kym Lansel, Gehl Architects
Jeff Risom, Gehl Architects

Laneways of Melbourne

Rob Adams, City of Melbourne
Paula Kilpatrick, City of Melbourne
Andrea Kleist, City of Melbourne
Fiona McGilton, City of Melbourne
Jack O'Connor, City of Melbourne
Ros Rymer, City of Melbourne
Bart Sbeghen, Bicycle Network

Pavement to Parks, San Francisco

Robin Abad Ocubillo, City of San Francisco
Ilaria Salvadori, Pavement to Parks

Plaza Program, NYC

Andrew Wiley-Schwartz, Bloomberg Associates
Emily Weidenhof, NYC Department of Transportation

Fort Street, Auckland

Ludo Campbell-Reid, Auckland Council
Eric Van Essen, Auckland Transport
Hayley Fitchett, Auckland Council
Simon Harrison, Auckland Council
Kitt Isidro, Auckland Council

Van Gogh Walk, London

Esther Kurland, Transport for London
Colette Lock-Wah-Hoon, Transport for London
Ben Plowden, Transport for London

St. Mark's Road, Bangalore

Swati Ramanathan, Jana Urban Space

Bourke Street, Sydney

Adam Fowler, City of Sydney
Fiona Gallagher, City of Sydney
Kerry Gallagher, City of Sydney

2nd Avenue, New York City

Matthew Roe, NACTO
Eric Beaton, NYC Department of Transportation

Götgatan, Stockholm

Daniel Firth, City of Stockholm

Swanston Street, Melbourne

Rob Adams, City of Melbourne
Paula Kilpatrick, City of Melbourne
Andrea Kleist, City of Melbourne
Fiona McGilton, City of Melbourne
Jack O'Connor, City of Melbourne
Ros Rymer, City of Melbourne
Bart Sbeghen, Bicycle Network
Dongsei Kim, AXU Studio

Avenue de Magenta, Paris

Maud Charasson, Apur
Patricia Pelloux, Apur

Avenida 9 de Julio, Buenos Aires

Soledad Aguirre Sors, City of Buenos Aires

A8ernA, Zaanstad

Kamiel Klaasse, NL Architects

Cheonggyecheon, Seoul

Lee Kim, AKRF, Inc
Prof. Soo Hong Noh, Yonsei University

Historic Peninsula, Istanbul

Cigdem Corek, Embarq Turkey

21st Street, Paso Robles

Brice Maryman, Svr Design
Nathan Polanski, Svr Design

Raahgiri Day, Gurgaon

Amit Bhatt, Embarq India
Kanika Jindal, Embarq India

Jellicoe Street, Auckland

Ludo Campbell-Reid, Auckland Council
Simon Harrison, Auckland Council
Kitt Isidro, Auckland Council
Megan Wraight, Wraight & Associates Ltd

Queens Quay, Toronto

Mark Van Elsenberg, City of Toronto
Pina Mallozzi, Waterfront Toronto
Mike Shenker, Waterfront Toronto

Khayelitsha, Cape Town

Kathryn Ewing, Vpuu
Barbara Southworth, Gapp Architects

Calle 107, Medellín

Maria Camila Mejia Pelaez, City of Medellín
Juan Andres Munos Airey, Edu

Street of Korogocho, Nairobi

Cecilia Andersson, Un Habitat
Laura Petrella, Un Habitat
Andrew Rudd, Un Habitat
Robyn Watson, Un Habitat

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Key Terms

Active Frontage

Active Frontage refers to the street frontages or edges that allow a visual or physical engagement between the street users and the ground floors of buildings. Frequent openings and windows with few blank walls; narrow-frontage buildings that give vertical rhythm to the street edge; facade articulation; transparency that promotes eyes on the street; and uses spilling onto the street contribute to active frontages. Making building edges “active” to the street adds interest and vitality to the street environment.

Active Mobility

Active Mobility or healthy transportation choices, refers to any form of human-powered transportation. These may include walking, cycling, or using a non-mechanized wheelchair that increases physical activity levels, positively impacting public health. All active modes of transportation are also sustainable modes of transportation as they leave minimal carbon footprint and do not contribute to carbon emissions.

Clear Paths

The pedestrian clear path defines the primary, dedicated, and accessible pathway on the street. It is an unobstructed, level, and smooth surface that ensures that pedestrians have a safe and adequate place to walk. Clear paths must be wide enough to allow two people in wheelchairs to pass one another, and are recommended to have a minimum width of **1.8 m**.

Daylighting (Intersection)

In intersection design, Daylighting consists of prohibiting parking and loading within a certain distance of an intersection to increase visibility between motorists and pedestrians. This can also be achieved through geometric design, by physically extending the curb, or raising the pedestrian crossing. Temporary or permanent bollards are often used to daylight intersections in low-compliance contexts.

Deflection

Vertical Deflection: It refers to speed control measures which involve the modification of the pavement elevation. When well-designed, vertical deflection measures self-enforce slower speeds for motorists. Examples include speed humps, speed cushions, speed tables, and raised crossings.

Horizontal Deflection: Horizontal speed control measures cause motorists to slow down in response to either a visually narrower roadway or a need to navigate a curving travel lane. Examples include curb extensions, pinch-points or gateways, chicanes, and lane and roadway narrowing that might result from the introduction of medians or pedestrian refuge islands.

Dooring

When a passing cyclist is struck by the sudden opening of a vehicular door in the door zone of a parked vehicle, it is referred to as Dooring.

Exposure and Risk

For the purpose of this guide, Exposure is defined as the state of being exposed to risk. It is measured as the probability of a user being involved in a crash. Risk refers to any situation involving exposure to danger, injury, or loss that may involve factors such as perception, willingness, and convenience. Mathematically, it is defined as injury rate calculated as the number of injuries or crashes over the amount of exposure, or over the population. Risk may apply to perception of risk or the tendency to take risk.

Facilities (Cycle or Transit)

Facilities, such as cycle facilities or transit facilities, are designated spaces within the street that are specifically designed for the movement of the given mode. Dedicated facilities ensure safe and efficient movement of the mode.

Green Infrastructure

Green Infrastructure is a planning and design approach to managing stormwater and other natural resources to create healthier environments. The term describes the network of green spaces and water systems that mimic those found in nature and values their ability to deliver multiple environmental, economic, and social benefits.

Infrastructure (Pedestrian, Cycle, or Transit)

Infrastructure refers to all facilities and amenities that may be used by the person using a given mode of transport. For example, in the case of pedestrians, it may refer to sidewalks, accessibility ramps,or benches, while in the case of cyclists, it may refer to cycle facilities, bike racks, parking, bike signals etc.

Interim Designs

Interim design strategies are a set of tools and tactics that cities can use to improve their roadways and public spaces in the near term. They include low-cost, interim materials; new public amenities, and creative partnerships with local stakeholders, which together enable faster project delivery, and more flexible and responsive design.

KSI or Road Traffic Fatalities

KSI stands for Killed or Seriously Injured and the definition may vary from country to country. For the purpose of this guide, seriously injured refers to a non-fatal injury received due to a crash which prevents the person from walking, driving, or normally continuing the activities the person was capable of performing before the injury occurred. Killed refers to road traffic fatalities, where the person dies within 30 days after collision due to injuries received in a crash. Road Traffic Fatalities refers to both Killed and Seriously Injured.

Mixed Traffic

The flow of traffic in which users and vehicles with different operating speeds and purpose are mixed without physical separation is referred to as Mixed Traffic.

Mode Share

Mode Share is also called mode split, modal share, or modal split. It is the share or the percentage of commuters using a particular type of transportation or number of trips using a type.

Roadway or Roadbed

Roadway, also known as roadbed or carriage way, is the part of a street is intended for vehicular movement, in contrast to a sidewalk or median. Often referred to as the curb-to-curb distance, it can be measured from one edge of the curb to the other.

Street Capacity

For the purpose of this guide, Street Capacity refers to the volume of people or total number of persons that a street can move in the given space and time, using any mode of transport.

Sustainable Modes

As the name suggests, any form of transport that is sustainable with respect to social, environmental, and climate impacts is a sustainable mode of transport. These modes do not use or rely on depleted natural resources. Instead, they rely on renewable or regenerated energy. This form of transport is socially equitable and offers increased mobility. This guide considers all active modes of transportation, collective transportation, along with vehicles using renewable energy, as sustainable modes of transportation.

Target Speeds

Target Speed is the fastest speed any user should travel; it should be determined based on the need of the users and context of the street and used as the design speed that, in turn, informs the posted speed limit. A proactive approach selects a Target Speed, and uses design to achieve that speed, guiding driver behavior through physical and perceptual cues.

Traffic Calming

Use of physical design and other measures, including narrowed roads and vertical or horizontal deflections, with the intention of slowing down or reducing motor-vehicle traffic and speed to improve safety for pedestrians and cyclists is known Traffic Calming.

Vulnerable Users

While all road users are at risk of being injured or killed in a road traffic crash, there are notable differences in fatality rates between different user groups. In particular, the Vulnerable Users such as pedestrians, cyclists, and motorized two-wheeler users are at greater risk than vehicle occupants and usually bear the greatest burden of injury. However, under the category of pedestrians, children, seniors, and people with disabilities are particularly vulnerable, as their physical and mental skills are either not fully developed or diminished.

Universal Accessibility

Universal Accessibility, in context of this guide, builds upon the principles of universal design. It refers to design that includes the needs of people whose physical, mental, or environmental conditions limit their performance. It aims to extend its definition to include people of all ages and abilities, who might be in a temporary situation of handicap at a given point. It addresses the larger issues of usability and access by making navigation and movement easier for everyone.

Notes

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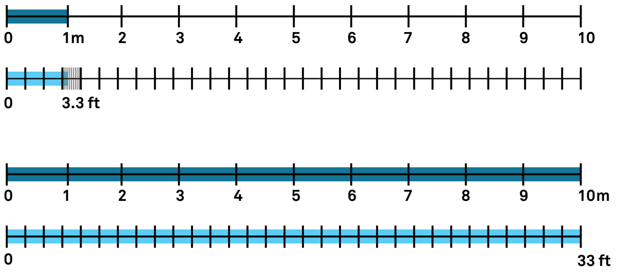
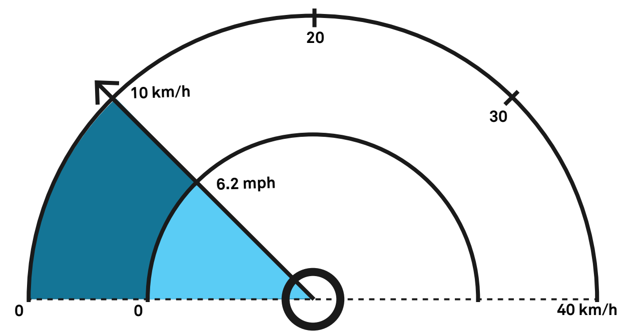
Appendix A | Conversion Chart



Distance Conversion Chart



Speed Conversion Chart

Distance

0.1 m = 0.33 ft
0.5 m = 1.65 ft
0.6 m = 2 ft
1.0 m = 3.3 ft
1.2 m = 4 ft
1.5 m = 5 ft
1.8 m = 6 ft
2.0 m = 6.6 ft
2.5 m = 8.2 ft
3.0 m = 10 ft
3.2 m = 10.5 ft
3.3 m = 10.85 ft
3.5 m = 11.48 ft
3.6 m = 11.8 ft
4.0 m = 13.12 ft
4.5 m = 14.75 ft
5.0 m = 16.4 ft
6.0 m = 19.5 ft
10 m = 33 ft
20 m = 65.6 ft
30 m = 98.4 ft
40 m = 132.21 ft
50 m = 164 ft
60 m = 196.85 ft
70 m = 228.65 ft
80 m = 262.5 ft
90 m = 295. 3 ft
100 m = 330 ft

Speed

1 km/h = 0.62 mph
5 km/h = 3.1 mph
10 km/h = 6.2 mph
15 km/h = 9.3 mph
20 km/h = 12.4 mph
30 km/h = 18.6 mph
40 km/h = 24.8 mph
45 km/h = 27.9 mph
50 km/h = 31 mph
60 km/h = 37.2 mph

Appendix B | Metrics Charts

Use the following tables to identify relevant metrics to evaluate your project and goals. These tables are a supplement to chapter 3: Measuring and Evaluating Streets and should be understood in conjunction with it. Measure the changes before and after the project, or over time, to generate data indicating a change in physical facilities, operations, or usage. Make use of the notes to document additional information around a metric for obtaining larger interrelated data sets for complete evaluation of a project. Note location and frequency of facilities. Count users across demographic parameters of age, gender, income, ethnicity etc.

Physical and Operational Changes

These metrics help document and evaluate the physical changes in street conditions, and the resultant operational shifts, in order to understand the impact of a particular project.

Category	Metric	Notes
Pedestrian Facilities		
Sidewalks	Sidewalks dimensions and area.	Measure total widths, clear paths, and furniture/frontage zone. Measure at multiple locations when dimensions vary.
Other Pedestrian Facilities	Number, dimension, length, and frequency of pedestrian crossings.	Overall, and by type and location, within the project area.
Sidewalk Quality*	Number and location of: • Pedestrian crossing signals • Seating • Wayfinding • Shade protections • Curb extensions • Pedestrian refuge islands • Parklets, plazas etc.	
Universal Accessibility*	Percentage or length of sidewalk surface in good condition.	Note potholes, obstacles, cracks, and trip hazards removed or total area resurfaced.
	Percentage and number of universally accessible facilities.	
	Length of wheelchair-accessible sidewalks.	Must be continuous and unobstructed.
	Number of accessible ramps installed.	Note frequency and alignment with other pedestrian facilities.
	Length of accessible path with textured guidance.	Must be continuous and unobstructed.
	Number or percentage of crossings with tactile paving at edge.	Number of street elements and furniture designed to be easily detected by visually impaired people (tonally contrasting markings, street bollards, waste receptacles, street signs, etc).
	Number or percentage of traffic signals with Audible Signaling Devices.	

***Location.** When relevant, note the location and spacing of these facilities for each of these categories.

Category	Metric	Notes
Cycle Facilities		
Facilities*	Length of cycle facilities by type.	Note width of travel path and buffers. Note length and percentage of continuous and connected cycle facilities.
Network	Percentage of total segments with safe and comfortable cycling facilities.	Include separated cycleways in streets above 30 km/h or shared access on slow streets of less than 30 km/h.
Intersections*	Number of intersections with cycle facilities and percentage.	Measure number. Note location of advanced stop lines/ cycle boxes, turn boxes, signal priority, and cycle detection.
Quality of Cycle Facilities	Percentage or length of cycle facilities surface in good condition.	Note potholes, obstacles, cracks, and trip hazards removed, or total area resurfaced.
Parking*	Number of cycle parking spaces.	Note percent occupied at various times of the day.
Cycle Share*	Number of cycle share facilities.	Note station size, location, and type. Note if conventional or e-bikes.

Transit Facilities		
Dedicated Lanes*	Length of transit lanes by type.	Note width, buffers, and passing lanes.
Intersections*	Number of intersections with transit facilities and percentage.	Measure number and note the location of queue jumps, transit priority signals, dedicated facilities, etc.
Quality of Transit Lanes	Percentage or length of transit lanes surface in good condition.	Note potholes, obstacles, vandalism, cracks, and trip hazards removed or total area resurfaced.
Transit Stops*	Number of stops/stations.	Note location, size, and type.
	Number and percentage of stops with shelter and seating.	Note seating types and capacity.
	Number and percentage of stops with off-board payment options.	
	Number and percentage of transit stops with wayfinding information.	Note number of interactive and audible devices.
	Number and percentage of shelters with real-time arrival information.	
Accessibility	Number and percentage of universally accessible transit stops.	Note walking distance to the transit station.

Motorized Vehicles Facilities		
Facilities*	Number and width of travel lanes.	
Parking*	Number of parking spaces.	Note if fixed or user activated.
Car Share*	Number of facilities and spaces for on-street car-share facilities.	Note if fixed or user activated.
Curb Cuts*	Number of curb cuts. Average number of driveways per 100 m of block frontage.	One way to Two way conversions and vice versa. Note daily directional/one-way/two-way changes, and timings.
Curb Radii	Radius of curb at intersection.	
Enforcement	Number of traffic-enforcement and traffic-control equipment (cameras, photo-radars, ANPR, average speed cameras).	Note location.
Quality of Lane, Roadbed	Percentage or length of roadbed surface in good condition.	

***Location.** When relevant, note the location and spacing of these facilities for each of these categories.

Category	Metric	Notes
Freight/City Services		
Facilities*	Number of loading bays.	Note length and size. Note number and length of loading zones per commercial block.
	Number of police or other reserved parking spaces.	
	Number of fire hydrants.	Note location.
	Number of waste and recycling receptacles.	Note spacing, size, and type.
Curb Cuts*	Number of curb cuts for loading bays in adjacent buildings.	Note width and location.
	Width of emergency vehicles access, number of bollards.	Note for shared streets and restricted areas.
Business/Commercial Spaces		
	Number and type of dedicated vending services.	
	Number of café/restaurant seats. Area occupied.	Note size and number of new businesses. Estimate number of informal or illegal vendors and their locations.
Other Street Conditions		
Street Dimensions	Width of cross section.	Calculate the width and/or the allocation of space per user. Calculate the right-of-way. Measure it at different points.
Intersections*	Number of intersections.	Note ratio of pedestrian and cycling intersections to motor vehicle intersections.
Block Size	Average block size.	Note where blocks are reduced below 100-150 m.
Green Infrastructure*	Number of trees and planters.	Note location, spacing, and tree pit dimension.
	Area or percentage of permeable surfaces.	Note materials used, rates of permeability, etc.
	Area and length of bio-swales and rain gardens.	
	Number of micro-generation facilities (solar panels, micro wind turbines)	Note location and quantity of energy resources generated.
Operational Changes		
Signal Phasing	Number of phases/duration and frequency of intervals.	
	Cycle signal duration.	Note if fixed or user activated.
	Pedestrian signal duration /frequency.	Note if fixed or user activated.
Street Operation	Number of streets in which lane direction has been changed and overall length.	One way to Two way conversions and vice versa. Note daily directional/one-way/two-way changes, and timings.
	Loading and parking hours.	
	Number and frequency of restricted turns.	Note location.
	Area covered by road pricing within the project area.	
	Frequency of temporary closures for events.	

***Location.** When relevant, note the location and spacing of these facilities for each of these categories.

Use and Functional Changes

The measurement and evaluation of changes in use, behavioral changes, user comfort and satisfaction, and functional shifts help you to understand the success of a project and its impacts.

Category	Metric	Notes
Movement/Access		
Mode share	Percentage of people walking, cycling, using collective transport and personal motorized vehicles. Percentage of trips as percentage of total.	This can be done in different ways: • Surveys: interview people (count all movement, not only commute). • Direct observation: count vehicles and apply a ratio of average occupancy of personal and collective vehicles.
	Average length of trip by mode.	Note peak hour averages.
	Percentage trips under 3-5 km.	
	Average speeds by mode.	
	Percentage of all drivers that comply with speed limits.	Note if personal, collective, or freight vehicles. Note speed limit.

Pedestrians		
Pedestrian Counts*	Number of people walking. PPD: Pedestrian per day. Pedestrian crossing volumes.	Measure at different times of the day/night (peak hour, off peak, lunch/dinner time, night, and season). Note their location.
Pedestrian Activities*	Number of people by type of activity.	Count how many people are moving, standing, sitting, waiting, socializing, or sleeping. Measure at different times (day/night, peak hour/off peak, lunch/dinner time, weekday/weekend, and season). Note location and duration of stay.
Pedestrian Behavior*	Percentage of users crossing compliantly or non-compliantly.	Count pedestrians crossing at intersection/mid-block, on marked or on unmarked pedestrian crossings, people walking on sidewalks and/or roadbed.
Pedestrian Satisfaction*	Percentage of users satisfied.	Identify user satisfaction of the new street and qualitative aspects of its use compared to the pre-project condition. Are users spending more time than before in the area? Are they visiting the area more frequently? Do they stay longer and why?
Pedestrian Comfort*	Percentage of users that feel safe and comfortable walking.	Quantitative surveys: Note stress levels/rating. Increased number of children, elderly, and women has been associated with safer walking environments.

Cyclists		
Cyclists Counts*	Number of people cycling/how. CPD: Cyclist per day.	Measure at different time of the day (peak hour/off peak, day/night, and season). Number of cycle share users. Note their location, the type of cycle (private, cycle share, etc)
Cyclists Behavior*	Percentage of users cycling compliantly.	Count people cycling on facility and/or roadbed. People cycling on sidewalks, or on pedestrian crossing, on transit ways, or not stopping at intersections.
Cyclists Satisfaction*	Percentage of users satisfied.	Identify users satisfaction of the new facility and qualitative aspects of its use compared to the pre-project condition.
Cyclist Comfort	Percentage of users that feel safe and comfortable using cycle facilities.	Quantitative surveys. Note stress levels/rating.

*** Demographic breakdown.** When relevant, for each of these categories, note age, gender, income, origin (where they live), ethnicity, and disability.

Category	Metric	Notes
Collective Transport		
Passenger Counts*	Number of people using collective transit.	Collect ridership surveys/counts, boarding and alighting counts by transit vehicle type and facility type. Examples: Daily passengers (passengers per day)
Passenger Behavior	Percentage of collective transit users compliantly waiting for transit.	Note passengers waiting at bus stop, on roadbed, on sidewalk clear path.
Vehicle Counts*	Number of transit vehicles by type.	Include all collective transit types (auto-rickshaw, mini-buses, buses, light rail, etc.). Note proportion of bus using dedicated lane and mixed traffic.
Driver Behavior	Percentage of drivers behaving compliantly.	Count collective transit drivers speeding, not stopping at intersection, etc. Note turning speed.
Passenger Satisfaction*	Percentage of users satisfied.	Identify user satisfaction of the new facility and qualitative aspects of its use compared to the pre-project condition.
Travel Time	Average travel time across the city.	Note along specific corridors.
Collective Transport Quality of Service	Frequency and on-time performances.	By transit type.

Private Motorized Vehicles		
User Counts*	Number of people using personal motorized vehicles.	
Vehicle Counts*	Number of private motorized vehicles.	Note average occupancy. Note type of vehicle (car share/ large/small)
Driver Behavior *	Percentage of users driving compliantly.	Note drivers speeding, not stopping at intersection, etc. Note turning speed.
Car Ownership	Number of cars for every 1000 inhabitants. Number of cars per family.	

Freight and City Services		
Commercial Vehicles and Freight Counts	Number of commercial vehicles and freight trips and percentage of total.	Break down by average size and type of vehicles and note peak delivery periods. Note urban freight delivery vehicles.
	Percentage of commercial vehicles and freight trips.	Measure as proportion of total vehicular trips.
	Number of hand-delivery carts or cargo bikes.	
Loading Zone Occupancy	Percentage of time the loading zones are occupied.	Photographic standards ranging from Good, Acceptable, Poor to Unacceptable can be set to evaluate streets across the study area.
Street Cleaning Services	Frequency of street cleaning services and waste collection.	
Perception of Cleanliness	Percentage of people perceiving the street as clean.	

*** Demographic breakdown.** When relevant, for each of these categories, note age, gender, income, origin (where they live), ethnicity, and disability.

Category	Metric	Notes
Business and Commercial Activity		
Establishments	Number of storefronts, establishments, and buildings per block/hectare or every 100 m.	Note operating hours and estimate proportion of economic activities.
	Number of floors and floor area by establishment type.	Note by location, type, and industry. Note if cultural establishments, business, recreational, or other. Note if public or private, for profit or not for profit.
	Number of jobs within the project boundary.	
Vacancy	Percentage of vacant floor space.	Note by location and type: office, retail, entertainment, recreational, and cultural space.
Rents	Retail rents.	Note increase or decrease in retail rents. Note rent control areas to compare the price variation.
Active Facades	Number of active entrances.	Note number of commercial and residential entrances.
	Percentage of facade transparency.	Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street. Percentage of glass walls, windows, doors over the total surface of the facade.
	Percentage of active frontage.	Percentage of street frontages where there is an active visual engagement between people on the street and people on the ground floors of the buildings. Note long stretches of blank wall and any set back areas.
Outdoor Events	Number and frequency of outdoor events.	Note by location and type, note if cultural events, recreational, or other. Note if public or private.
Vendors	Number of vendors.	By location and type.
	Number of sidewalk café permits.	Note renewals and new issuances.
	Number of vending permits.	Note renewals and new issuances.
	Number of people in paid or restricted area.	

Other Street Functions		
Land Use	Building uses, land use, and density.	Note the change in land use and density within the project boundaries. Note areas of mixed land use.
Vacancy	Number and percentage of vacant buildings, lots, and parcels.	Note by location and type: office, retail, entertainment, recreational, and cultural space.
Lighting	Percentage of project area well-lit (without darkspots) by facility.	Note the number of light poles that are in front of residential windows.
Shade	Percentage of the street with shade.	Measure at different time of the day.
Energy Efficiency	Amount of electricity consumed.	Electricity consumed within the project area by street lighting and other public facilities.
	Amount of electricity produced via micro-generation.	Collect the amount of electricity produced by solar panels, small wind turbines, etc., within the project area.
Green Infrastructure	Percentage of $C0_2$ potentially captured by trees planted.	Estimate the amount of $C0_2$ that can be potentially captured by trees and plants (within the project area).
	Volume and percentage of treated/cleaned stormwater.	Measure the volume and part of total stormwater cleaned by the green infrastructure.
	Amount of stormwater runoff diverted from city systems.	Measure the volume and part of total stormwater absorbed by permeable surfaces.
Participation	Number community members who participate in public meetings, hearings, and outreach.	Measure if project increased citizen involvement and participation.
Recycling	Percentage of waste collected that is recycling.	Note part of recycling collected as portion of total waste.

Evaluating the Impacts

Measuring and evaluating street projects can help estimate overall neighborhood and citywide impacts.

	H&S	QL	ENV	ECO	EQ		
Road Safety	High	High	Low-Moderate	Low-Moderate	Low-Moderate	Number of crashes/year* Number of KSI/100,000*	Break down by mode, user. Note the location, time of the day/night.
Personal Safety	High	High		Low-Moderate	High	Crime rate* Crime/100,000	Murders, rapes, armed robberies, violent, and non¬violent crimes. Note the location, time of the day/night.
Access to Physical Activity	High	High		High	High	Percentage of people meeting daily recommended physical activity levels *	
	High	High	Low-Moderate	High	High	Percentage of people walking or cycling on a daily basis*	
	High	High		High	High	Percentage of population obese or overweight*	
Health and Chronic Diseases	High	High	Low-Moderate	High	High	Percentage of population with heart disease*	
	High	High		High	High	Percentage of population with depression*	
	High	High	Low-Moderate	High	High	Percentage of population with respiratory diseases*	Transportation-related pollutants are one of the largest contributors to unhealthy air quality.
Air Quality	High	High	High	Low-Moderate	Low-Moderate	Level of particulate matter, CO_2, ozone	
Noise Pollution	High	High	High	Low-Moderate	Low-Moderate	Level of noise from trucks and automobile traffic and other street activities	Less than 92 dB is recommended for trucks and less than 82 dB for cars.
Visual Pollution	High	High	High	Low-Moderate	Low-Moderate	Percentage of visual clutter	
Light Pollution	High	High	High	Low-Moderate	Low-Moderate	Levels of sky glow and glare	Estimate the percentage of visible sky and the darkness of the night sky.
Water Quality	High	High	High	Low-Moderate	Low-Moderate	Levels of water pollutants	
Standing Water	High	High	High	Low-Moderate	Low-Moderate	Drainage rates after heavy rain events	
Biodiversity	High	High	High	Low-Moderate	Low-Moderate	Number of species	
Heat Island Effect	High	High	High	Low-Moderate	Low-Moderate	Average temperature	
Natural Disasters	High	High	Low-Moderate	Low-Moderate	Low-Moderate	Number of flooding events	
	Low-Moderate	High	High	Low-Moderate	Low-Moderate	Disaster mitigation elements included in street design	
Access	Low-Moderate	High	Low-Moderate	Low-Moderate	High	Number of people living 10-min walking distance and 10-min cycling of transit facilities, and key services, including access to fresh, healthy food	
	Low-Moderate	High	Low-Moderate	Low-Moderate	High	Total travel times by mode/user	
Real Estate		High		High	Low-Moderate	Real estate values, property values, rents, property taxes	Evaluate change in property taxes.
Employment		High		High	Low-Moderate	Number of jobs	Evaluate the number of jobs created.

*** Demographic breakdown.** When relevant, for each of these categories, note age, gender, income, origin (where they live), ethnicity, and disability.

User Legend:

- **H&S** Health and Safety
- **QL** Quality of Life
- **ENV** Environmental Sustainability
- **ECO** Economical Sustainability
- **EQ** Social Equity
- High Impact
- Low-Moderate Impact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Appendix C | Summary Chart of Typologies Illustrated

The chart below provides a summary of the types of streets presented in chapter 10: Streets; their overall dimensions, some basic information on space allocation among users, and the case studies explored. They are not a mandated set of dimensions, but rather examples of the various ways existing streets can be transformed.

Each street illustrates multiple examples that vary in context, overall size, geometric alignment, and in certain cases, transit type. The transformations shown are based on proven strategies and real contexts, which illustrate an integrated approach to street design.

For the purpose of clear communication, streets are shown as orthogonally aligned, with the understanding that adjustments should be made to adapt to specific local conditions.

Chapter 6: Designing for People will help provide alternative alignments and configurations for each typology and can clarify recommended dimensions.

	Examples	Right-Sidewalk of-Way	Sidewalks		Cycle Facilities		Transit Lanes		Lanes of Traffic		On-Street Parking		Case Study
			E	R	E	R	E	R	E	R	E	R	
10.3 | Pedestrian-Priority Spaces													
Pedestrian-Only Streets	1	18 m	4 m						2	0	●		Strøget Copenhagen, Denmark
	2	22 m	6 m						2	0	●		
Laneways and Alleys	1	8 m	1.5 m						1	1	●		Centre Place Laneway Melbourne, Australia
	2	10 m	4.5 m						1	1			
Parklets	1		3 m	3 m					1	1	●	●	Pavement to Plazas San Francisco, USA
Pedestrian Plazas	1	32 m	4 m	6.5 m					4	4			Plazas Program New York, USA
10.4 | Shared Streets													
Commercial Shared Streets	1	18 m	4 m						2	0	●		Bourke Street Sydney, Australia
	2	22 m	6 m						2	0	●		
Residential Shared Streets	1	8 m	1.5 m						1	1	●	●	St Mark's Road Bangalore, India
	2	10 m	4.5 m						1	1	●	●	
10.5 | Neighborhood Streets													
Residential Shared Streets	1	13 m	2.5 m	2.5 m		●			2	2	●	●	Bourke Street Sydney, Australia
	2	18 m	2.5 m	4.5 m		●			2	1	●	●	
	3	24 m	3 m	3.5 m		●			4	2	●	●	
Neighborhood Main Streets	1	18 m	1 m	4.5 m		●			2	2	●	●	St Mark's Road Bangalore, India
	2	22 m	2 m	4.5 m		●			4	2	●	●	
	3	30 m	5 m	7.5 m		●			4	2	●	●	

User Legend:

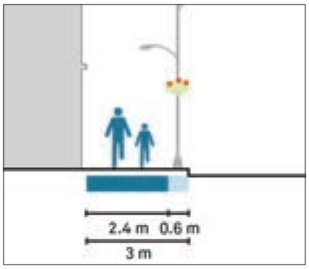
E	Existing
R	Redesigned

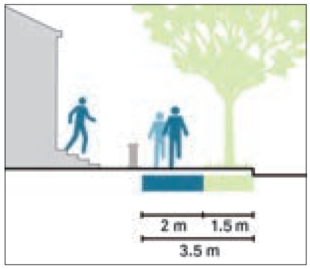
	Examples	Right-Sidewalk of-Way	Sidewalks		Cycle Facilities		Transit Lanes		Lanes of Traffic		On-Street Parking		Case Study
			E	R	E	R	E	R	E	R	E	R	
10.6 | Grand Streets, Avenues, and Boulevards													
Central One-way	1	18 m	3.5 m	5 m		●			2	1	●	●	Second Avenue New York, USA
	2	25 m	4 m	5.5 m		●			2	1	●	●	
	3	31 m	6 m	6 m		●		●	4	2	●		
Central Two-way	1	20 m	2 m	4.5 m					2	2	●	●	Gotgatan Stockholm, Sweden
	2	30 m	1.5 m	6 m		●		●	6	2			
	3	40 m	6.5 m	9 m		●		●	6	2	●	●	
Transit Malls	1	16 m	6 m	10 m				●	2	0			Swanston Street Melbourne, Australia
	2	32 m	5 m	8.5 m		●	●	●	4	0	●		
	3	35 m	4 m	6 m		●		●	4	0	●		
Large Streets with Transit	1	32	4 m	6.5 m				●	6	2		●	Boulevard de Magenta Paris, France
	2	38	2 m	6 m			●	●	6	2	●	●	
Grand Streets	1	52	5.5 m	7.5 m	●	●	●	●	6	4	●	●	Avenida 9 de Julio Buenos Aires, Argentina
	2	60	4 m	7.5 m		●		●	8	6	●	●	
	3	76	4 m	8 m		●		●	10	6	●	●	
10.7 | Special Conditions													
Elevated Structure Improvement	1	34 m	3 m	5.5 m		●			4	2	●		A8ernA Amsterdam, The Netherlands
Elevated Structure Removal	1	47 m	3m	6 m		●		●	10	4	●	●	Cheong-gyecheon Seoul, Korea
Streets to Streams	1	40 m	6 m	6 m		●			8	2			Paso Robles California, USA
Temporary Closures	1					●							Rahagiri New Delhi, India
Post-Industrial Revitalization	1	20 m	0	5 m		●			4	2	●	●	Jellicoe Street Auckland, New Zealand
Waterfront and Parkside Streets	1	30 m	2.5 m	5.5 m		●			8	4		●	Queen Quay Toronto, Canada
Historic Streets	1	N A											Historic Peninsula Istanbul, Turkey
10.8 | Streets and Paths in Informal Areas													
N A		N A											Calle 107, Medellín, Colombia
N A		N A											Khayelitsha, Cape Town, South Africa
N A		N A											Street of Korogocho, Nairobi, Kenya

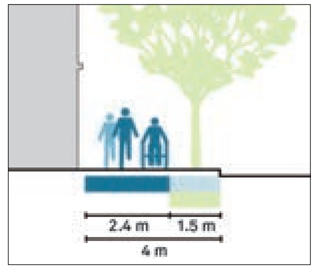
Appendix D | User Section Geometries

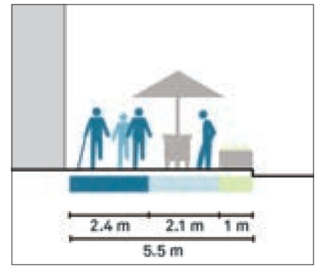
The Designing for People chapter explores various street users, their networks, scale, geometries, and supporting elements. A summary of the basic street geometry sections has been compiled below for reference.

Pedestrians









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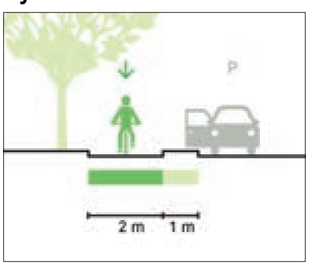
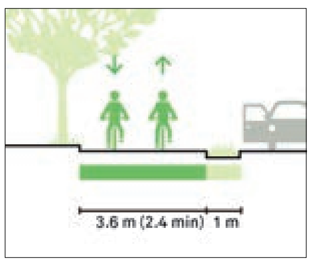
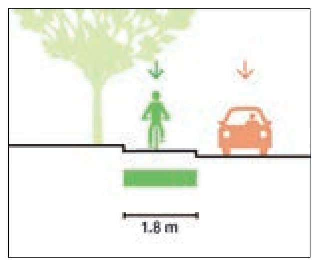
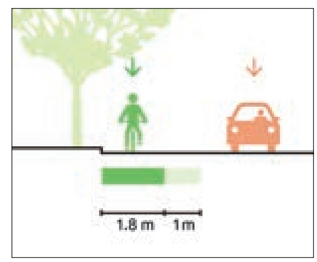
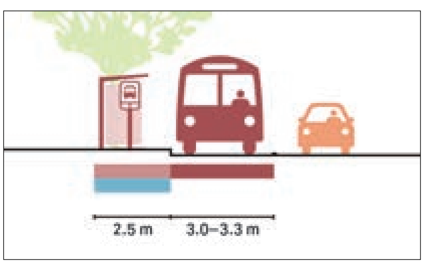


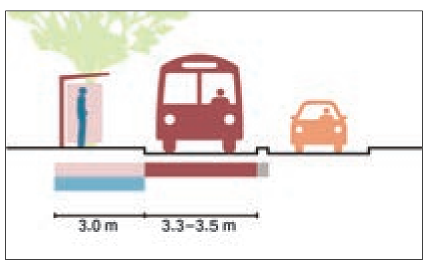


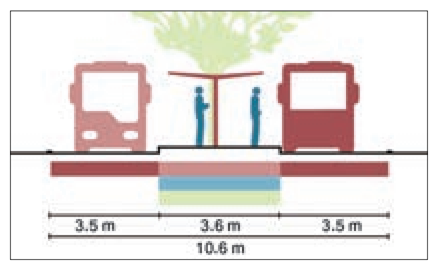




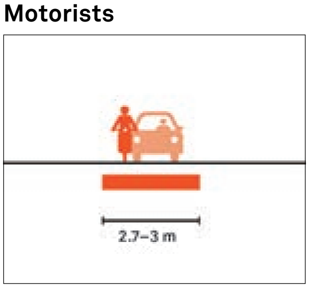
Transit Riders

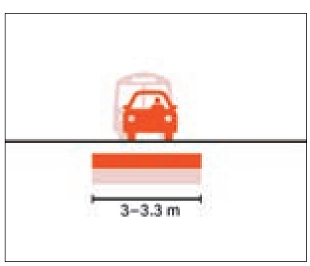


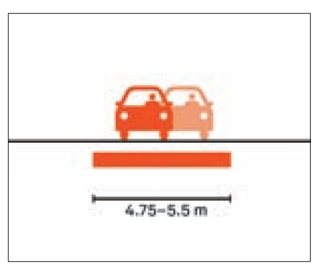


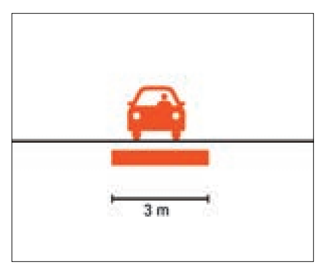


Motorists

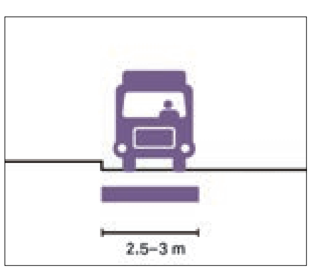


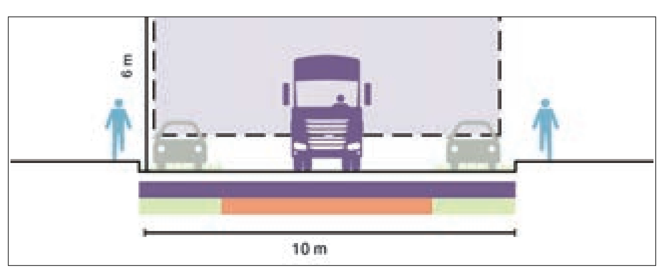




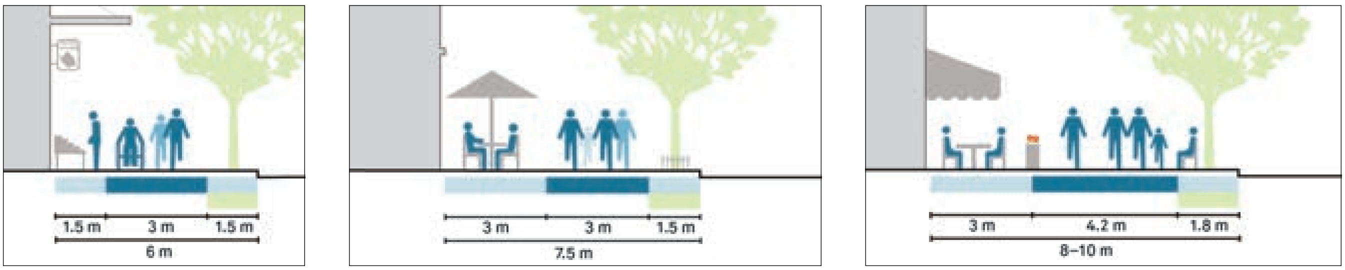


Freight and Service Operators

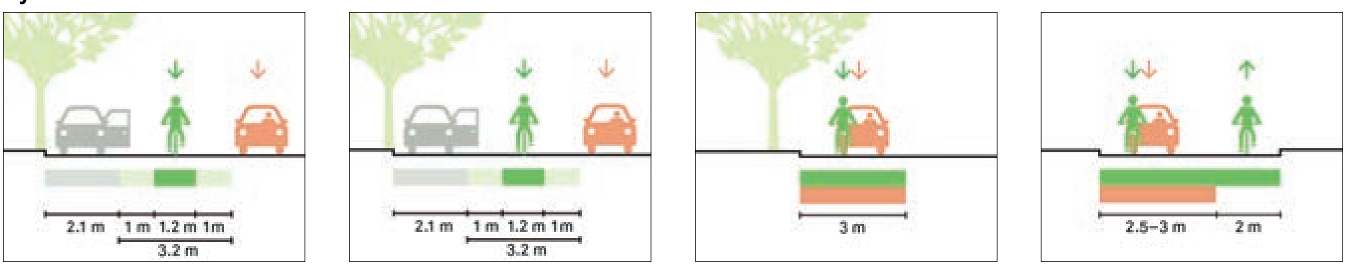




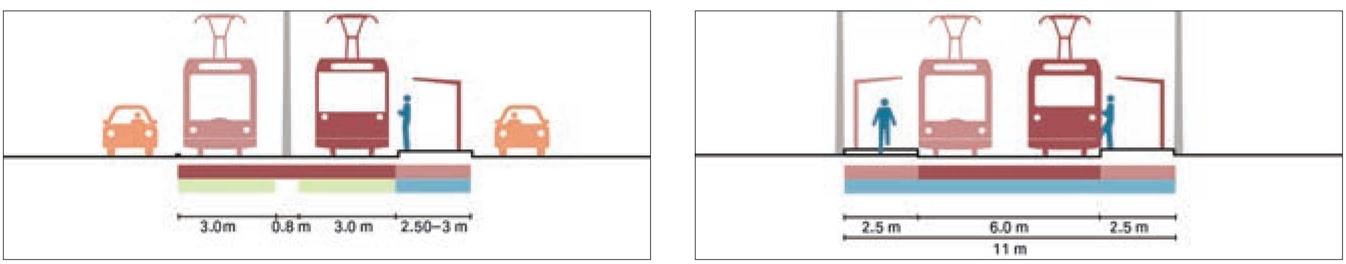
Pedestrians



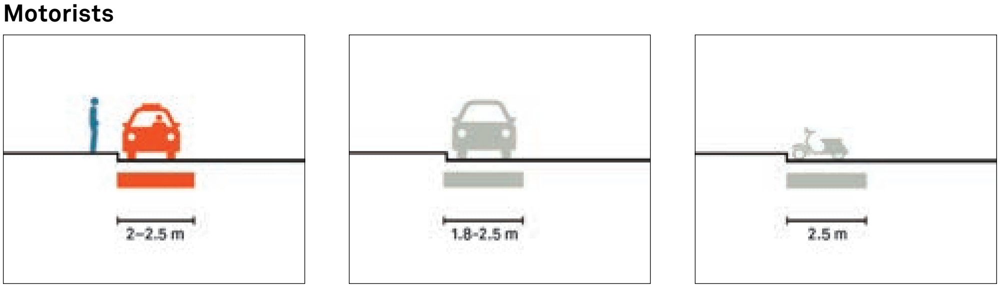
Cyclists



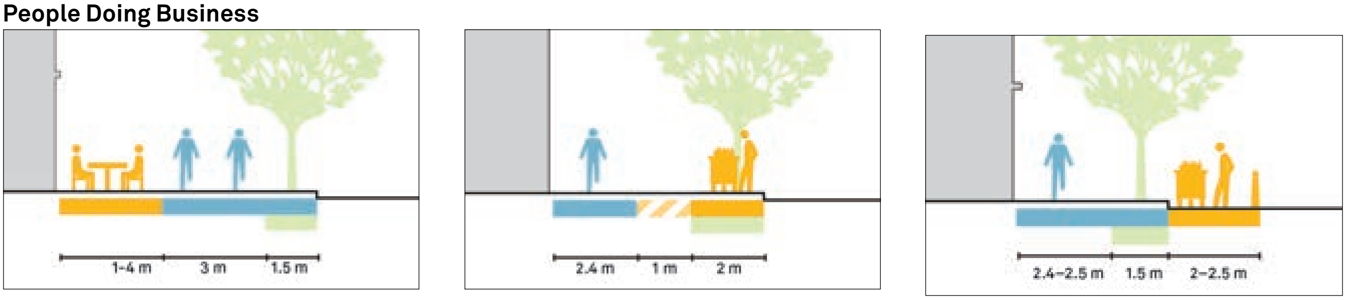
Transit Riders



Motorists

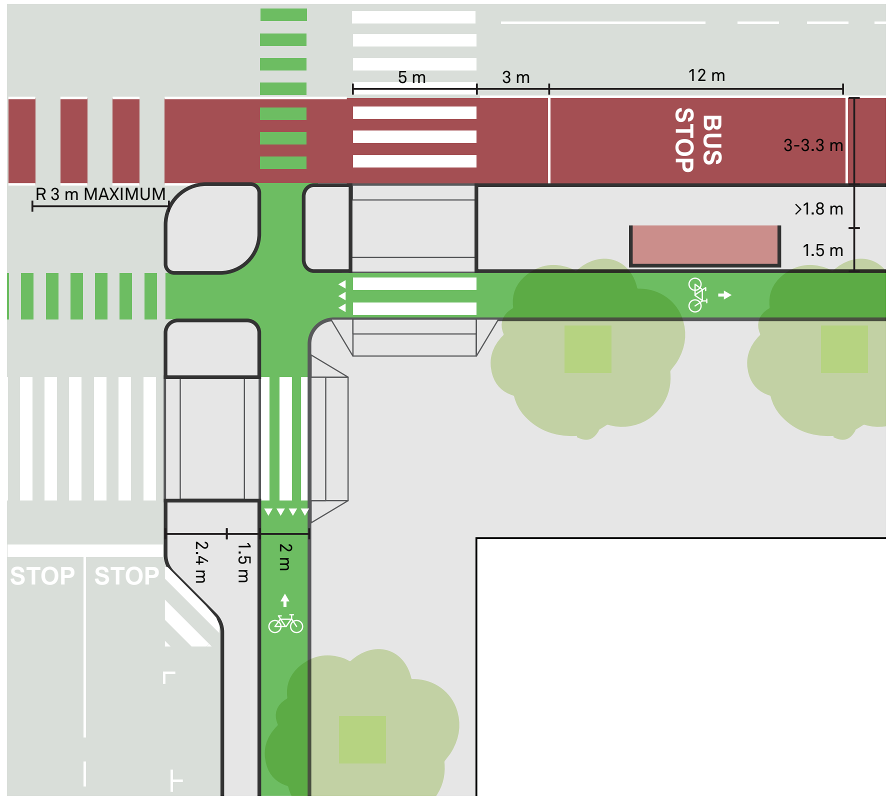


People Doing Business



Appendix E | Assumptions on Intersection Dimensions

The streets illustrated in this guide show a range of conditions. Due to limited space, dimensions have not been annotated. The following diagrams represent some of the assumed dimension ranges in the illustrations. Basic widths, spacing, slopes, and turning radii correspond to the Designing for People, Streets, and Intersections chapters.



Corner Radii

Minimize corner radii to slow turning vehicles, keep intersections compact, and ensure safe, pedestrian-friendly spaces. Corner radii in urban areas can be as small as **0.6 m**. *See 8: Operational and Management Strategies.*

Green Infrastructure

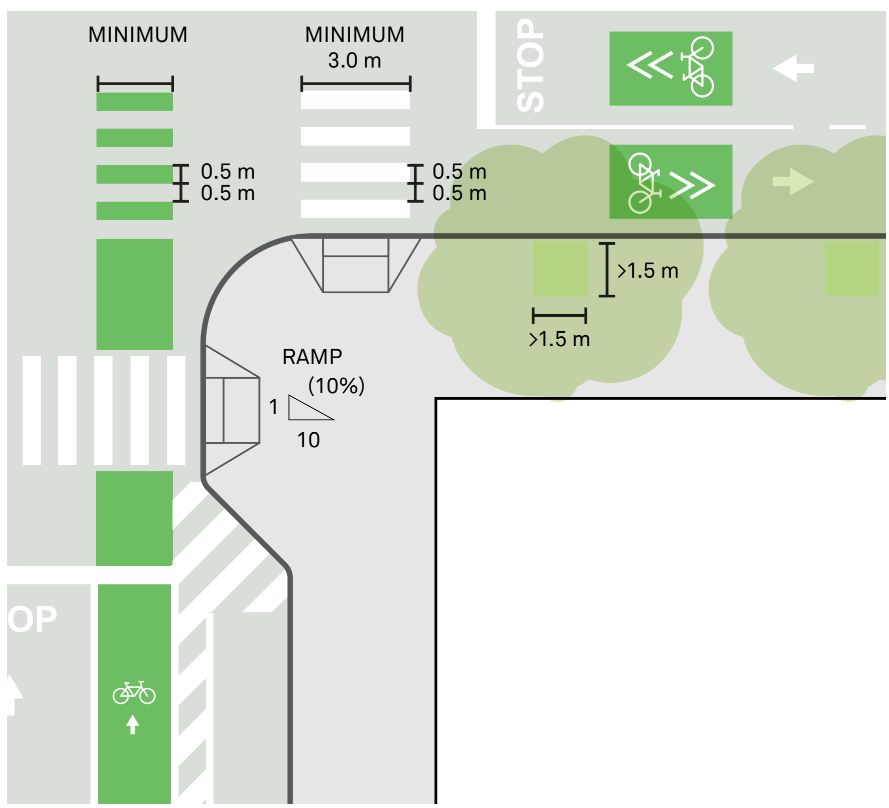
Include green infrastructure strategies in the furniture zone of the sidewalk, in curb extensions, or in medians. *See 7.2: Green Infrastructure.*

Accessibility Ramps

Design accessibility ramps at each crossing. These should be placed at 90 degrees to the path of movement and should not exceed a slope of **1:10**. *See 6.3.8: Universal Accessibility.*

Curb Extensions

Add where possible to shorten crossing distances, improve visibility, and provide additional waiting space for pedestrians, space for transit shelters, vendors, or green infrastructure. *See 6: Designing for People.*



Transit Stops and Shelters

Ensure accessible walking paths are maintained on sidewalks. The space between the structure and the curb edge should allow for accessible transit boarding. Space shelters **3 m** from intersections. *See 6.5: Designing for Transit Riders.*

Cycle-Protected Intersection

Provide physical separation for cyclists at intersections where possible. Continue markings through intersection to alert drivers and cyclists of potential conflict zone. *See 6.4: Designing for Cyclists.*

Cycle Boxes

When cycle-protected intersections cannot be included, use advanced stop cycle boxes to allow cyclists a safe and visible way to move ahead of queuing traffic when stopped at a red light. *See 6.4: Designing for Cyclists.*

Sidewalks

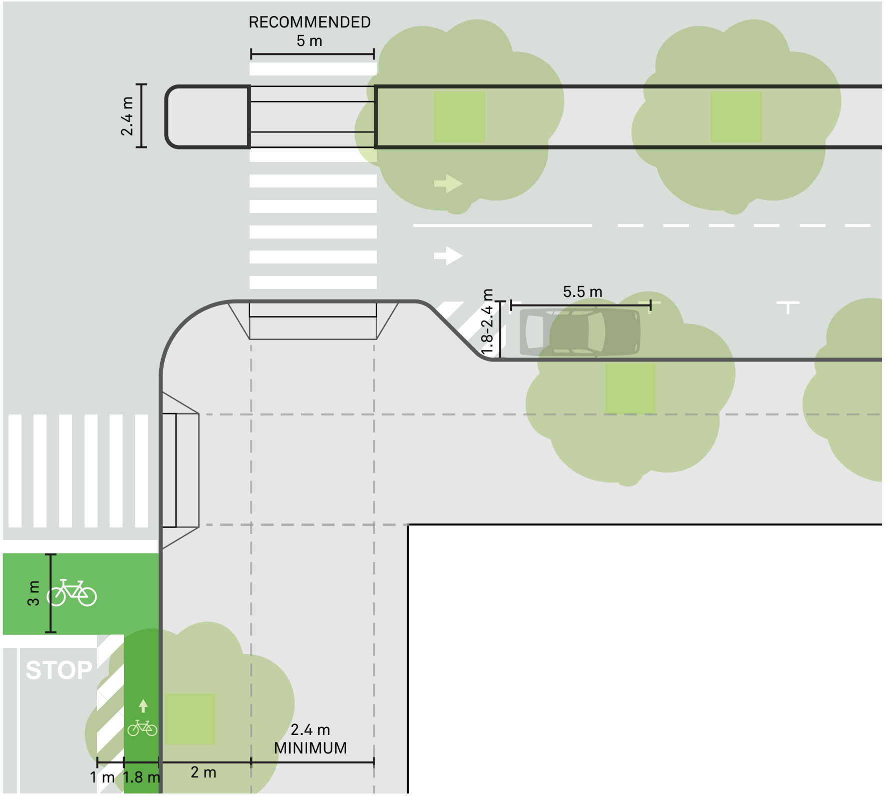
Ensure sidewalks maintain a continuous and unobstructed clear path of **2.4 m** (absolute minimum 1.8 m) to allow two wheelchairs to comfortably pass each other. *See 6.3.4: Sidewalks.*

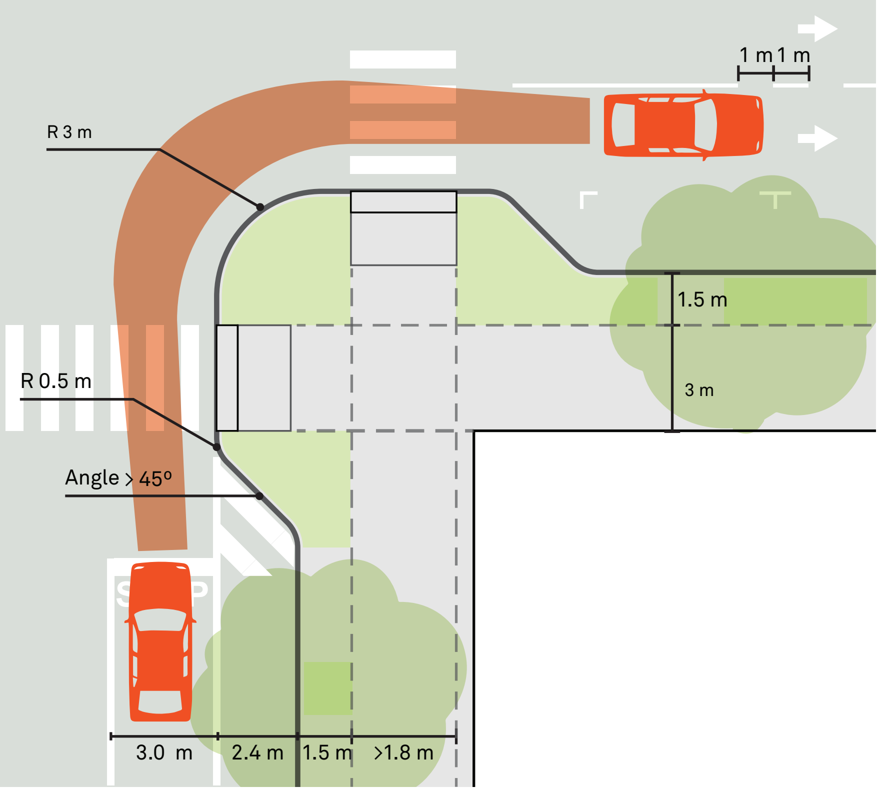
Pedestrian Crossings

Ensure pedestrian crossings align with the pedestrian clear path and are clearly marked to indicate safe places to cross. *See 6.3: Designing for Pedestrians.*

Pedestrian Refuge Islands

Provide spaces for pedestrians to wait when crossing more then two or three lanes of moving traffic. These places should be the same width as the marked crossings and be **2.4 m** deep to safely allow people to wait. *See 6: Designing for People.*





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Photos are indicated by "f."

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